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$5,000 from Chicago!

Advices received at a late hour Friday are to the effect that the Chicago Gas Companies have given $5,000 to the Fair Fund. We greet them *a deux mains*. Our readers will please study the lines of our current editorial on the Fair Fund through the new light with which this subscription floods them.

THE FAIR FUND.

It is our disagreeable task this week, as it has been for the past fortnight, to report slow progress with the gathering up of the Fund for the gas exhibit building at the World's Fair of 1893. Since Wednesday last, the sum added was $350, in a sinple supscription from the proprietors of the Charleston (S. C.) Gas Light Company, which was a liberal addition to the funds individually, but the bleak fact remains that the Charleston Company was alone on the list. The sentiment, however, of the great majority of those who have subscribed, decidedly favors the proposition of constructing a building in keeping with the moneys that shall have been pledged at a certain date named for the closing of the subscription. This, of course, is for the Council and the subscribers to ultimately determine, but we feel confident that those who have earnestly entered into the spirit of this thing will not be satisfied to admit that failure, ignominious and complete, is to be the end of it all. Nor do we believe that any of the subscribers has put a string around his offering, or that any subscription has been made in the thought or hope that the money so pledged would never be paid over, from one or any cause. The extension of time for the completion of the building (to about April 1, 1893), gives ample space or opportunity to secure the money needed—we presume that $100,000 would at a pinch be equal to the completion of the building—and we again most urgently request the believers in the future of the gas business to put in at once the amount that they feel they can spare—we might better say invest, for there is absolute certainty that the return made in the shape of increased gas sales the country over as a result of the gas exhibit at the Fair, will be many times in excess of the amounts contributed—to the end that profit may come to all. In the meantime, the inexplicable attitude of the Chicago Companies is maintained, which is in direct conflict with the principles that usually govern the business actions of such men as Messrs. Billings, Benedict and others, who largely dominate the course of the Chicago Companies; nor can there be any gainsaying the fact that this inaction on their part has acted woefully as a damper on the will of others who think, and justly so, that those who are to be benefited most should be the first to subscribe, and liberally. The exact state of the fund, up to Wednesday morning, July 6th, is appended:

July 2. Charleston (S. C.) Gas Light Company	$350 00
Amount previously published	60,231 28
Grand total (to July 7)	$60,581 28

BRIEFLY TOLD.

THE TESTIMONIAL DINNER TO MR. GREENOUGH.—The handsome special dining parlor of the Hotel Brunswick, Boston, held a distinguished and representative gathering of gas men on the afternoon of June 30th, who were there to speed a parting colleague, in the person of Mr. Malcolm S. Greenough, who for over a score of years was prominent in the engineering management of the Boston Gas Light Company. In fact, it seems not exactly in accordance with the regular order of things to write the name of Greenough as one who *was* in the service of that Company; the *present* would seem more like the regular order. While *tempori parendum* means much, yet in yielding to the spirit of the hour, change does not signify defeat. The Greenoughs will always be remembered as the props of the staid old Boston Company, and as the father was so the son is—a man of probity, skill and decision; hence change in this instance not only does not signify defeat, but is the herald of advance. Malcolm S. Greenough resigns his charge at Boston to take advantage of a wider and more positive field at Cleveland, which situation needs a positive man just now to repair the damage that ultra-conservatism has wrought there. We do not wish to be misunderstood in this reference to the Cleveland situation, and so shall speak plainly. The proprietors of the Cleveland Gas Light and Coke Company—and by proprietors we mean the shareowners and the chief executive man-

agement thereof—were so conservative that they refused to reward the people in their employ in any manner commensurate with the value of the services that were faithfully rendered. Office managers and staff, engineering heads and their subordinates, received salaries that were—well, not in any sense large; and while the proprietors pocketed the proceeds, they failed to remember those who piled up the profits. This indifference at home caused eventually the formation of an indifferent spirit to the opinions of anyone outside of the charmed stockholding circle; and the ultimate result is what the whole gas world now knows—the forcing upon them of a gas rate that is unjust and ridiculously inadequate. We believe that no one is particularly grieved over the plight, personally, in which the leading Cleveland shareholders are placed, but in that placing they have put a menace over gas shareholders at large. This menace may not be worked out in many other situations to the disadvantage of investors, but the saving clause or force will be that in those situations a different policy in dealing with the authorities and with the employees has been followed.

So it will be seen that Mr. Greenough enters upon a field that requires the presence of a tactful, resolute, skillful man; and such he surely is. With a free field and no hampering he can, if anyone may at the present time, make a success of 75-cent gas.

With the knowledge that he was to go out from them, it was most fitting that his confreres should wish him God-speed in hearty fashion, and those whose privilege it was to participate in the testimonial dinner at Boston last month can bear witness to the fraternal spirit that leavened the feast. The arrangements for the dinner were under the charge of Messrs. W. A. Wood and C. F. Prichard, and the mention of these names is sufficient guarantee that everything was done as it should have been to have everything at its best. The guests numbered 50, several of whom travelled hundreds of miles to be present, and those who were represented by letters of regret sent their messages of fraternity from almost every State in the Union. The President of the American Gas Light Association, Capt. W. Henry White, acted as Toastmaster, and did, as he always does on those occasions, wonderfully well. While it might not be in exact good taste to refer here to the fraternal expressions of regret at Mr. Greenough's renunciation of his Boston work, it will not be out of place to say that he must many a time in his new field of labor recall with a swelling heart the expressions that greeted him from those who dined at the Brunswick on the last day of June.

The Meeting of the Incorporated Gas Institute.—The 29th annual general meeting of the Gas Institute was brought off, in London, in mid-June, under the Presidency of Mr. W. A. Valon, before a large attendance. The meeting was a most successful one in every respect. Mr. Valon had much to say in his annual address—in fact, if any adverse criticism is tenable against it at all, it is that he sought to compass to much in its lines—not a little of which is of interest to American engineers. He alluded very feelingly to the loss sustained by the Institute in particular, and the industry in general in the death of Mr. G. Shepard Page, and also referred at some length to the proposed gas exhibit at the World's Fair. Mr. Valon is certain, by-the-way, that the separate gas exhibit is assured. Oil and water gases also come in for a large share of attention, not only in the address, but in the paper-list as well, and extended reference to American practice in these was made. The Birmingham medal was bestowed upon Dr. Perkin, for his discoveries in connection with the aniline colors, and the venerable Doctor made his acknowledgments in person of the honor. Seven papers were read, and Prof. Lewes delivered one of his inimitable lectures. Next year the meeting will be presided over by Mr. Denny Lane, and the sessions will be held at Belfast, Ireland.

Attention is called to the inquiry in this issue, from the Detroit Gas Light Company, for bids on about 160,000 gallons of coal tar per year, from the works. Rates for a term of 1, 3 or 5 years are asked for.

Another chapter in the Cleveland gas situation is afforded in the passage of an ordinance by the City Council entitled, "An ordinance to create a fund, to be known as the City Hall Fund, and to be used for the purchase of a site and the erection of a City Hall." The fund is to be created from the moneys paid over by the local Gas Companies under the operation of the Meyer-Rose ordinance monstrosity, whereby the Companies are obligated to pay to the city 6½ per cent. of their gross receipts annually. The fund addenda directs that the money "shall, as the same is paid into the city treasury, be placed to the credit of a fund known as the City Hall Fund, which fund shall be used for the purpose of purchasing a site for and erecting a City Hall building, or for either of said purposes, and for no other purpose whatsoever."

[A Paper read by Mr. Frederick G. Dexter, of Winchester, before the Incorporated Gas Institute.]

Steam Applied as an Aid to the Revivification of Oxide of Iron "in situ."

The purification of gas in closed vessels is not by any means a new subject. It has received close attention (more particularly of late years) at the hands of many able men, and under varying circumstances. The "Claus" process and the "Oxygen" process representing modern attempts, probably owe their birth to the attention drawn to possible results by the introduction to the purifiers of a small percentage of air with the crude gas.

It is not the writer's intention to take up the time of the meeting by recapitulating the many theories, opinions and facts which have been given from time to time in support of, or in opposition to, the air process, as ordinarily tried or saddled with the cost of carbureting. They are, more or less, all well known to you. One paper in particular by Mr. Valon, our President, given in the Institute "Transactions for 1889," summed up the debatable question very shortly. He, having tried the effect of air purification and found it (at any rate under his circumstances) objectionable, had immediately set about trials with oxygen pure and simple, with the truly beautiful results already recorded. That paper, in effect, seemed to tell us that both opponents and exponents of air revivification were wrong—the only true solution being oxygen undiluted. In the subsequent discussion, Mr. N. H. Humphrys found himself unable to reconcile the statement that ½ per cent. of free oxygen mixed with 99½ per cent. of crude gas—or rather a mixture of crude gases—could differ in active properties from ½ per cent. of oxygen mixed with a similar quantity of crude gases, because the said 99½ per cent. of mixture in the second case had 2 per cent. of nitrogen with it, passed in with the oxygen as air. There can be no doubt that the incredulity then expressed found an echo in many other minds. But it appeared to me, after the reading of that paper, and in spite of the very interesting results brought to light in the "History of a Heap of Oxide" given by Mr. Humphrys, that the days of air revivification were numbered, if the facts there recorded were substantiated in other quarters, and no better results were possible. During the same discussion, Dr. Thorne, in endeavoring to throw some light upon the discrepancy between results obtained with air and oxygen (the percentages of oxygen being identical), said: "But the chemical world was startled some few years ago by experiments made by Professor Harold B. Dixon and others, in which it was shown that if the oxygen were perfectly dry—in a state of dryness such as, until that time, had been quite unknown—then the power of the oxygen to support combustion was enormously *decreased*. One might heat sulphur in *dry* oxygen to such a point that it sublimed, without its burning; and one might heat a piece of charcoal in oxygen to a bright red heat, take the flame away, and it would go back again without any visible burning. But the moment the merest trace of moisture was introduced the effect was quite different; the carbon, or sulphur, or phosphorus, or whatever it might be, immediately burst into flame." These remarks, and others of a similar nature, had considerable weight in my own mind; and although I had often thought upon the "Air *versus* Oxygen" question before, without arriving at any satisfactory solution, the conviction then flashed upon me that in this quality of dryness lay the secret—not, however, in the form of accounting for oxygen being so far superior to air, but as explaining why air had not been made to more closely approach oxygen under conditions suitable to its use.

Moisture plays a most important part in nature; its combinations are inconceivably numerous, and but few chemical reactions are possible without its aid. The instances given by Dr. Thorne might be multiplied many times over. To give one which immediately occurred to my mind—the simple process of rust formation on iron. Here there is a chemical combination—practically combustion, evolving a certain degree of heat. It is the union of oxygen and iron with that all-important aid, moisture. Does rust, or oxide of iron, form in a current of perfectly dry air, however much prolonged? The ferric hydrates, or natural bog ores, contain in their natural state as much as 50 per cent. of water. Even if treated with dry sawdust before use, they will frequently contain (as used in the purifiers) 25 to 30 per cent. of moisture. Artificial oxides also are of necessity "watered" before use; and it is hardly needful for me to remind members of the practice of "watering" oxide when spread upon the revivifying floor, and even of the practice, as I once heard, of raising a purifier lid to water the contents, as an aid to greater efficiency.

Having, I trust, drawn your attention to the fact that damp oxide is of recognized importance, and that when oxide has been allowed to get

thoroughly dry its efficiency in the box is seriously curtailed, I wish to point out that the air process as ordinarily applied is directly responsible for and rapidly brings about this very evil—the drying of the oxide; while, as far as I am aware, not only have no efforts been made to counteract this evil, but apparently the matter has altogether escaped the attention it deserves. A few months since, I had the honor of presenting to the Southwest Association of Gas Managers a paper dealing with the "Revivifying of Oxide of Iron in Closed Boxes," by means of a blast of air, derived from a pressure blower; the box being disconnected from the working series during the operation. The same idea, carried out, however, in a different way, had previously been attempted, but abandoned owing to the extreme difficulty experienced with the hardening or caking together of the oxide. This obstacle, I felt convinced, could be overcome by the use of suitable opening material and proper attention to the humidity of the oxide. The subject is here introduced only to show the effect produced in a case analogous to the subject of the present paper. I found that the heat produced during the chemical reactions or revivification of the oxide was quite sufficient to drive off, in the form of vapor, the water liberated by the reactions, as well as any mechanically mixed with the material. It was, in effect, simply baking out the moisture; and if the meeting will recall for a moment the caking together and hardening effect in the case of the drying up of common mould, mud, clay, or any similar material, it will not be found difficult to account for.

To satisfy myself thoroughly upon this point, I had arrangements made to condense the moisture blown off with the air and gases at the plug of the purifier, and I carefully compared samples of the same material immediately before applying the air blast and after. The result showed me that considerable quantities of water were driven off by the agency of the heat of the reaction; and the difference between the condition of the oxide before and after treatment with air was most marked. In fact, if the air was not well controlled, it was quite possible to so harden or dry off the layer first affected as to render it impervious to the air current for all practical purposes. Here, then, appeared to me an explanation of a common difficulty, and sometimes entire want of success experienced by users of the ordinary air process.

The chemical reactions effected within an oxide purifier treated with a small percentage of air are of precisely the same character as occur with the same oxide removed to the revivifying floor, or to a spent box treated by a blast in the way just referred to. But while the reactions are similar, the conditions are very different. Oxide revivified upon an an open floor has this advantage—the heat disengaged can get away quite freely, without necessarily raising its temperature to any great extent. It is, if dry, in a position to absorb moisture from the atmosphere; and, further, should the material not be in a sufficiently damp state, its condition would undoubtedly be noticed, and the necessary moisture added by watering before it was replaced in the box. In applying the air process, however, what occurs? The heat formerly allowed to escape is pent up; it is allowed to become intensified to such an extent, at times, as to cause the oxide and sulphur to fire, and the grids to burn. This catastrophe, while admittedly due to mismanagement, as it shows want of attention to the correct proportioning of the air supply, still serves the purpose of illustrating the intensity of the reactions produced. It is simply a question of degree, the amount of heat liberated in a given time depending entirely on the rapidity of the air supply in conjunction with the condition of the oxide. The quantity of heat is at all times more than sufficient—especially well within the layers—to cause the rapid evaporation of moisture, the presence of which is one of the most important conditions of success.

It is to be noted that the abstraction of moisture acts detrimentally in two ways—mechanically and chemically. (1) Mechanically, by the drying up, hardening, or caking together of the oxide, which causes greater resistance to the passage of the gas. (2) Chemically, by impairing the active properties of the oxide. Of the former effect, many have in the past given their experience; and several instances could be given of boxes shut off, long before properly spent, through sheer inability to get the gas through the material, which has even required the use of pickaxes to disengage. Of the latter, or chemical aspect, I do not think the last word has yet been said. In fact, I am coming to the conclusion that, if the mechanical difficulty did not first assert itself, and put an end on this score alone to further work, the oxide could be so deprived of moisture as to put an almost entire stop to revivification. I hope, before concluding these remarks, to give such evidence on this point as will clearly indicate the necessity of attention in this direction.

In jotting down information in connection with Mr. Valon's and Dr. Thorne's remarks on the oxygen process, as given in the paper before referred to, and in connection with the various experiences recorded with the air process, as well as my own experiments, I had the following notes:

(1) A given percentage of free oxygen admitted to purifiers appeared to have far higher revivifying effect than exactly the same percentage of oxygen admitted in conjunction with 2 per cent. of nitrogen as air.

(2) The presence of moisture is of primary importance in most chemical reactions. It is known to have an extraordinary influence upon the combination or activity of the particular element under consideration—*i. e.*, oxygen.

(3) The absence of moisture in oxide used for purification has an injurious effect; special steps being always taken under ordinary circumstances to ensure its presence.

(4) The production of hydrated ferric oxide in the active form absolutely depends upon water for its constitution, whether the reaction from sulphide takes place on the revivifying floor or inside a purifier.

(5) That, while the conditions of revivification on an open floor favor the assimilation of moisture either naturally or artificially, the conditions of the closed box not only directly preclude this, but, by means of the heat produced, aid the abstraction of moisture, driving forward along with the gas whatever might be liberated chemically or exist mechanically mixed.

(6) That the difficulty of back-pressure caused by caking, was again directly traceable to the removal of moisture.

(7) That, in revivifying purifiers by an air blast taken in at the bottom, and the current removed at the top, revivification always proceeded in the reverse direction to the blast—*i. e.*, from the top downwards. But, while the top material with less air became damp from moisture driven forward from lower layers, the bottom, which took longer to revivify, though in contact with more air, remained very dry.

The enumeration and study of these points led to but one conclusion. The air process tended to become self-destructive by the removal of the necessary moisture; and although at some works a greater measure of success would be experienced than at others—due to the varying amount of moisture present in the oxide originally, or in the gas, or the proportion of air used—yet there appeared very good ground to believe that no results were so good but that they could be greatly improved. The present uncertainty as to the possible life of any box could be reduced to definite lines, if the important question of humidity received the necessary attention.

While collecting these notes, and trying the effect of the ordinary air process with the admission of varying quantities up to a little over 2 per cent., a circumstance occurred which seemed to me to put all doubt at rest. The ordinary process had been working for some time, with results apparently as satisfactory as were obtained elsewhere. Speaking generally, the boxes, while gradually increasing in back-pressure, did not give exceptional trouble, necessitating shutting off, except in a few instances, or towards what appeared to be the limit of their life by ordinary tests. Having occasion to change over to a separate section of retort house, attention was called within two days to the impossibility of getting the gas through the purifiers. A new box having been added only four days before, I could not for awhile account for this extraordinary behavior; the back-pressure on the first of the series having risen in this short time from 4 to 18 inches. On shutting this box off, and making the second box the first, a similar increased resistance arose within the next 30 hours, and again a repetition with the third box. This was a very serious matter; and upon investigating into the cause I found that each box became decidedly warm in comparison with the temperature usually found. I at once came to the conclusion that the mischief arose through an increased quantity of air being drawn in owing to some fault in the new retort section which was put to work. This surmise proved correct; and the oxide, having been removed, broken up, and freshly damped, was again used in turn with no further difficulty. This experience convinced me that, if means were devised to prevent moisture leaving the oxide under revivification, or, if it did do so, to replace it continuously, the greatest possible benefit would result.

I saw that, according to "King's Treatise on Coal Gas" (Vol. 1., p. 377), Mr. Cleland, in applying a jet of steam for scrubbing purposes, claimed a saving of one-third in labor and material (oxide) in the purifiers, by reason of the complete removal of ammonia and arrestation of tar oil and *water* before the gas reached the oxide of lime purifier. This indicates that one of the conditions of success was that the moisture or steam should be prevented from entering the purifiers; and probably at that time, without the altered conditions of air revivification, the

object was so far right. Under the conditions here discussed, however, the reverse is true. Moisture is urgently needed. Mr. George Anderson on the subject of "Gas Purifiers," in his paper read in 1889, said: "He formed the opinion that to purify gas there must be humidity; and the more humidity there was without doing damage, the better." *Exhaust* steam having necessarily the greater part of its heat removed, appeared to me one of the best possible means of introducing moisture—being itself nothing but warm water vapor, in the finest possible state of division, and therefore readily adaptable to bring about complete admixture with the gas, and consequently in the most favorable state and condition to come into contact with the oxide.

On thinking over the details for the proposed trial, it occurred to me that the gas itself would probably exercise an affinity for, and take up a certain proportion of, moisture, if allowed to come into contact a sufficient time—added to which it would be necessary to adopt some means of control in case the amount of exhaust steam admitted should prove too great, or the reverse, as my idea was to turn to account the exhaust from the exhauster engine. Having at my disposal an annular condenser, I applied the exhaust steam by means of two jets—one above and one below the gas inlet; and the path of the steam being at right angles to that of the gas, thorough admixture was obtained. To still further break up and intermix gas and steam, I fitted the annular spaces with wood and pine shavings supported upon rings at intervals, in a very similar manner to Cleland's scrubber. This arrangement prevents undue compression of the material at the lower layers. Each of the tubes was fitted with shower-rings, by which a stream of water could be made to descend upon the material; and provision was also left to enable the steam to be applied at different points, so as to carry forward, or prevent the passage of, any proportion of steam required.

I am pleased to be able to say that the results have been quite successful. Extended trial over many months with comparatively small and large air percentages, both with and without steam, leave no room to doubt the marked superiority resulting from its use. Careful records were kept of the effect of air alone during nearly twelve months' working; and during last season in applying steam, I kept, as nearly as circumstances would permit, to the same percentages at similar times of the year, in order to ensure parallel conditions:

The average results obtained are as follows:—

(1) During the summer months, with 2 per cent. of air and no steam, the gas purified per box averaged 3,000,000 cubic feet.

(2) Under similar conditions of make in summer with 2 per cent. of air *and steam*, the average quantity purified per box was 7,000,000 cubic feet.

(3) During the winter months, with 0 8 per cent. of air only and no steam, the average life per box was 2,400,000 cubic feet.

(4) With steam added and 0.8 per cent. of air (under conditions otherwise the same), the life per box rose to 7,200,000 cubic feet.

I may mention that the oxide used in these trials contained from 36 to 40 per cent. of sulphur; and the gas on entering the purifiers while under steam was at a temperature of from 90° to 100° F. The efficiency of the oxide in each box was raised by the help of steam from twice to three times its normal value—the greatest increase of efficiency being obtained in winter, when ordinarily, by reason of increased flow and low temperatures, the efficiency is generally lowest.

The specific points and advantages arising from the addition of moisture in this way may be briefly enumerated as follows:—

(1) The steam supplies the necessary moisture to preserve the activity of the oxide.

(2) The oxygen of the air supply seems, as Dr. Thorne suggested, to possess far more active properties under the influence of moisture. At any rate, a comparison of statements 1 and 2 or 3 and 4 singularly confirms this.

(3) Back-pressure from hardening or caking is absolutely stopped. This I attribute to the prevention of the drying-up effect, and also to the undoubted fact that the sawdust and woody fiber in oxide swells considerably, thus tending strongly to disintegrate the mass, rather than allow it to bind.

(4) The high temperature of the ingoing gas, particularly in a humid condition, is distinctly favorable to the oxidation, and to the chemical reactions generally.

(5) The addition of heat in this way is of great importance in winter, counteracting most satisfactorily the inert action of the oxide under severe cold, prolonging the life of the box, and enabling far greater dependence to be placed on the purifying operations.

I am quite aware that, to render this paper more complete and worthy of your acceptance, I should embrace within it extended statistical reference to the exact analysis of the oxide and of the gas, before and after operations, together with information as to the actual amount of water used, the purifying area, and similar details. But I am placed at some disadvantage in being called upon to supply a paper at very short notice; and I am consequently unable to deal so fully with the matter as could be wished. This detailed statistical work is not yet ready; and as my trials are still progressing, I think, perhaps, it would be better to include the details in some future paper—that is, if the subject is thought worthy of a further hearing—though I am quite willing to give to the meeting now any information in my possession likely to be of assistance.

By giving the results under exactly parallel conditions, and at similar times of the year, one is placed in a better position for judging of the value of my contention. I believe that, when rightly administered and rightly understood, air applied in small proportions will be found of more value than the larger doses now are, which are often administered under unfavorable conditions. With careful attention, we may, perhaps, remove to some extent the discrepancy between air and oxygen.

[Concluded from page 6.]

On Platinum Pyrometers.

[A paper read by Mr. H. L. Callendar, M.A., before the Iron and Steel Institute, Great Britain.]

So far I have described only the construction of the pyrometer itself. The construction of the indicating portion of the apparatus, and the method of measuring the resistance, is a question of almost equal importance.

The resistance of one of these pyrometers can, of course, be measured by any of the usual methods, but the sensitiveness and accuracy attainable depend very largely on the selection of a suitable method and apparatus. In the case of the Siemens pyrometer, the differential galvanometer method has been adopted. A resistance-box is used reading to $\frac{1}{10}$th of an ohm, which corresponds to about 3° F., and a table is issued giving the resistance for every 20° F. The disadvantages of this method are (1) that the readings are discontinuous, (2) that it is necessary to refer to the table and do an interpolation sum to find the temperature.

The differential galvanometer method is, moreover, for other reasons unsuitable for accurate work. It is essential to use the Wheatstone bridge method. For use with my own pyrometers I have adopted the most accurate modification of the latter method, in which a bridge wire is used for reading the fractions. The advantages of this method are (1) its superior accuracy; (2) that the readings are continuous; (3) that the divisions of the wire may be made to correspond directly to degrees of temperature. The principle of the method has already been described and explained in a paper published in the *Philosophical Magazine* for July, 1891. The following is a diagram and description of a form of resistance-box specially made for the purpose (Fig. 1).

The pyrometer leads marked *P* and *C* are connected to the terminals marked *P* and *C*. The battery is connected to the terminals marked *B*, and the galvanometer to the terminals marked *G*. *A D* is the divided wire with a millimeter scale and verneir H, reading to $\frac{1}{100}$ of a degree. *E F* is an adjustable set of resistance coils. The numbers on the heads of the screw-nuts *F* to *F* give the equivalent values of the corresponding resistances in centimeters of the bridge wire. The resistance coils themselves are compensated, so that changes of temperature of the box do not affect their values.

In taking an observation, resistances are unscrewed or unplugged in the arm E F, and the galvanometer contact piece H is moved along the wire till the balance is found. The reading of the bridge wire, added to the sum of the coils unscrewed, gives the value of the temperature directly in degrees on the platinum scale.

With this apparatus 1 centimeter of the divided wire corresponds to 1° C. It is not difficult to make the galvanometer sensitive to $\frac{1}{100}$th of a degree at 1,000° C., and, of course, $\frac{1}{10}$th of a degree, which corresponds to one millimeter of the bridge wire, can be read with tolerable ease and certainty.

With these instruments it is not only possible to read with certainty to a tenth of a degree at 1,000° C., but what is more surprising and important, the readings are actually constant and consistent to this fraction of a degree. I have made several experiments to test this point. Some typical illustrations will be found in a series of experiments made at the Royal Mint in conjunction with Professor Roberts-Austen, and described in the *Philosophical Magazine* for February, 1892. In the present state of our knowledge I do not think it would be

possible to construct a pyrometer on any other principle, to read with anything approaching to this degree of accuracy. There are very few instruments that can be made to read even to 10° with certainty at 1,000° C., and the possible errors of most pyrometers are much larger than this.

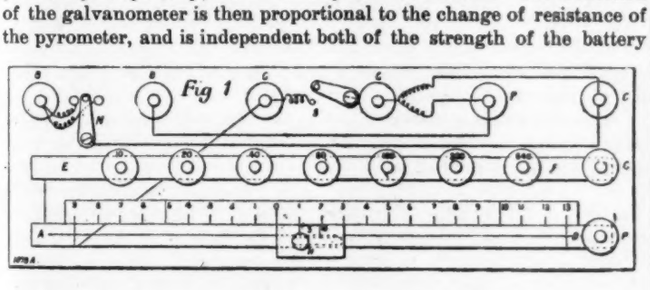
It may be objected that so high a degree of accuracy is not required for most practical purposes. It is, however, undoubtedly valuable for scientific work, and, of course, there is no difficulty in constructing less delicate instruments in cases where the highest degree of accuracy is not required.

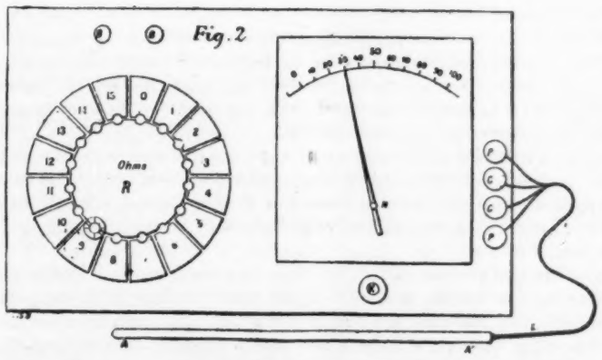
For the most accurate work the bridge wire or "null" method possesses undoubted advantages. For practical purposes, however, it is in many cases more convenient to use a "deflection" method. In the Wheatstone bridge method, and also in the differential galvanometer method, the resistance is measured by balancing it against another resistance, which is adjusted by trial until the balance is obtained. This necessity of continuous adjustment is particularly troublesome in cases in which the temperature is varying, and in which, for this very reason, a high degree of accuracy is out of the question.

A platinum pyrometer can, however, be easily arranged so that the odd degrees of fractions are directly indicated by the deflection of the galvanometer, instead of being found by sliding the contact piece along the bridge wire till the deflection is nothing. If, however, the ordinary form of galvanometer be used, its deflection will depend on the strength of the battery as well as on the change of resistance. It is, therefore, necessary either to use a constant battery or to compensate the galvanometer so that its deflections are independent of the battery power. The second plan is, in my opinion, the best. Constant batteries are very liable to get out of order, and are never quite constant. It is better to use an ordinary electric bell or telephone battery, and to compensate the galvanometer.

The deflections of an ordinary galvanometer will also vary with the resistance and temperature of its coils. The galvanometer must, therefore, also be compensated for change of temperature of the air, so that it may give the same readings in summer and winter. Since, after all, the galvanometer deflection is only used for giving the odd 20 or 30° and not the whole temperature, this might be regarded as a superfluous precaution; but it can easily be shown that this is not the case if you wish to read with certainty to a tenth of a degree.

I have recently succeeded in compensating a galvanometer in a comparatively simple way, so as to satisfy both conditions. The deflection of the galvanometer is then proportional to the change of resistance of the pyrometer, and is independent both of the strength of the battery





and of the temperature of its coils. With a mirror galvanometer, compensated in this way, it is possible to read to a tenth of a degree with tolerable certainty at 1,000° C. My own instrument gives an angular deflection of 25 minutes for 1° C., with a possible error of less than 5 minutes in a deflection of 15° of arc.

Most people who are not practical electricians find a mirror galvanometer rather difficult and troublesome to work with. For ordinary purposes a needle galvanometer is sufficiently accurate and certainly much easier to read. Fig. 2 represents the arrangement of the apparatus for working with a needle galvanometer at any temperature up to 1,500° C.

$A\,A^1$ represents the pyrometer in its containing tube connected by the flexible leads $L\,L$, which may be of any convenient length to the terminals $P\,P$, $C\,C$ of the indicator. A common Leclanche or dry battery is connected to the terminals $B\,B$. By means of suitable switches, not shown in the diagram, any number of different pyrometers in different places may be alternately switched on to the same indicator. The needle N of the galvanometer is furnished with a long, fine index, which moves over a scale divided into 100 parts. R is a resistance box, preferably of dial form, and mounted on the same base as the galvanometer. The travelling plug T can be inserted in any one of the holes, so as to vary the resistance in the circuit. The resistance of the pyrometer is adjusted so that a change of 1 ohm corresponds to 100° C. or F., whichever may be preferred. The remaining coils and resistances forming the Wheatstone bridge are contained in the galvanometer case. The connections, etc., are not shown in the diagram, to avoid unnecessary complication.

In taking an observation, the temperature is generally known beforehand to within 100°. The plug T is inserted in the corresponding hole. The key K is then depressed, and the needle of the galvanometer at once indicates the odd degrees and fractions. In the position shown in the diagram the temperature indicated is 930°. When the needle falls below 0 the plug T must be shifted backwards. When it rises above 100° the plug is shifted the other way. An arrangement is also provided for keeping the key K permanently depressed when the temperature is to be indicated continuously.

The use of this form of instrument requires no special electrical knowledge or skill. The observations are such as any intelligent workman can readily make. It is many times more sensitive than any of the ordinary forms of pyrometers, its readings are also much more constant and trustworthy, and there are no calculations to be made or corrections to be applied.

For many kinds of rough work, and particularly for work in furnaces and blast pipes, it is not necessary to read with this degree of accuracy throughout the whole scale. In many cases the temperature is only required roughly, say to 5° or 10°. For this purpose the auxiliary resistance-box R may be dispensed with, and the whole temperature indicated by the deflection of the galvanometer. This, of course, makes the apparatus much simpler and cheaper, as the resistances are expensive and difficult to adjust. By suitably adjusting the scale of the galvanometer it can be made to cover any desired range, such as 0° to 1,000° C. or F., instead 0° to 100°.

In cases where greater accuracy is desired, but only over a small range, such as 1,000° C. to 1,300° C., the resistance-box may also be dispensed with, the pyrometer and the galvanometer scale being adjusted so as to start reading at the desired point. One great advantage of these pyrometers lies, in fact, in the ease with which they can be adapted to suit any particular kind of work.

Another advantage of these pyrometers, which I pointed out some years ago, is that different instruments when properly adjusted, agree in their indications very closely indeed throughout the whole scale. In the case of pyrometers constructed of the same wire the largest difference I have hitherto observed is only half a degree at 1,000° C., and even in this case I cannot be quite certain, because the pyrometer which showed the divergence was not quite so well made as the others. With pyrometers constructed of different specimens of wire the divergences are still very small, even if the electrical coefficients of the wires differ by as much as 10 or 15 per cent. In any case such small differences are readily dealt with, in cases where a high degree of accuracy is required, by reducing the indications by means of a table of corrections to those of a standard instrument.

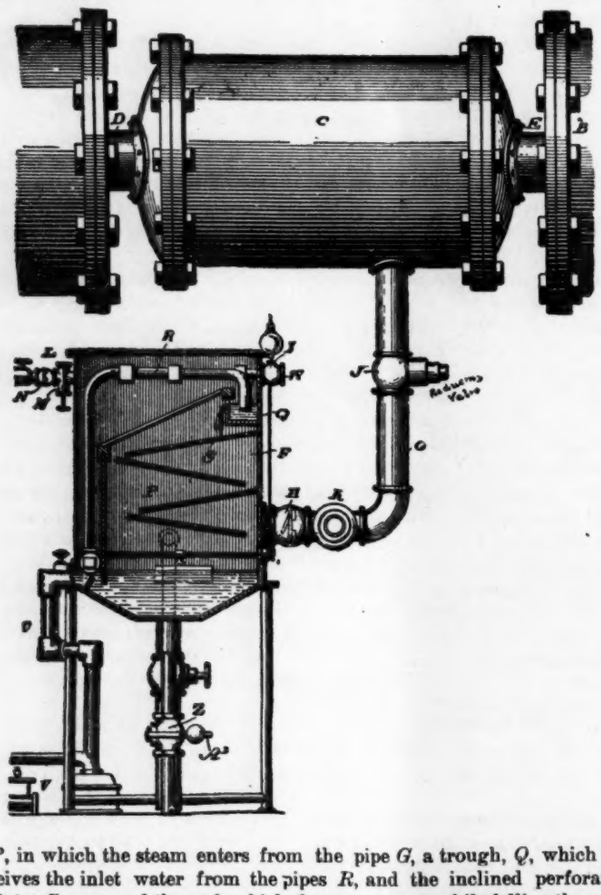
For practical purposes it is comparatively little use to endeavor at present to reduce the indications to the scale of the air thermometer, because the latter instrument cannot at present be made to read with certainty even to 10° or 20° at 1,000° C. To the practical man it does not very much matter whether the scale of his instrument be Centigrade or Fahrenheit, or absolute or arbitrary. What he wants is an instrument which will always give the same indication at the same temperature, so that, having once discovered the temperature necessary or most suitable for any particular process, he can make certain of reproducing the same conditions at will at any future time. This desirable result can, I believe, be most perfectly attained, as far as our present state of knowledge goes, by the use of platinum pyrometers. Since different platinum pyrometers can be made to agree very closely in their indications, the results obtained by different observers will then be fairly comparable if expressed on the platinum scale. If the

greatest accuracy is desirable the readings can be still further reduced to the scale of some particular standard pyrometer. In this way we shall at least be able to secure uniformity in place of the bewildering discrepancies at present existing. The platinum pyrometer will preserve the standard, and if at any future time it becomes possible to make more accurate measurements with the air pyrometer, all the observations previously made will not be simply wasted, as they are under the existing want of system, but can at once be expressed in terms of the new standard.

Webster's Feed Water Heater.

The apparatus herewith illustrated is the feed water heater that is being put on the market by Messrs. Warren Webster & Co., of Philadelphia. The first specimen put in work was one rated to serve a 500-horse power boiler, and was used in connection with a pair of compound engines at the works of W. F. & F. C. Sayles, Saylesville, R. I. The second, of the same size, was furnished upon trial to the Merrick Thread Company, of Holyoke. A series of experiments was made by Samuel M. Green, the mechanical superintendent of the company, who found the results sufficient, in his estimation, to permit the adoption of the heater in connection with their plant.

Reference now being had to the drawing, *C* is a steam receiver placed between the cylinders of a compound engine of the usual form. A feed-water heater and purifier is shown, *F*, with a pipe, *G*, communicating with the receiver. This pipe is provided with a check valve, *H*, for preventing the water which is in the heater from entering the receiver through the branch pipe, which might occur under certain conditions, and *J* and *K* are pressure reducing valves of any ordinary construction for lessening the pressure of the steam from the receiver *C* before it enters the heater. The heater is provided with an air outlet pipe, *L*, having an automatically operated air-inlet valve, *M*, of usual construction, and a check valve, *N*. The heater has a vacuum chamber,



P, in which the steam enters from the pipe *G*, a trough, *Q*, which receives the inlet water from the pipes *R*, and the inclined perforated plates *S*, over and through which the water passes while falling through the trough, in which the supply pipes empty. A discharge pipe, *U*, conveys the feed water from the heater to the pump *V*.

It is usual in heating feed water in connection with a compound engine to pass the exhaust steam from the last cylinder through a coil heater to a condenser, where, owing to the vacuum which is there maintained, the exhaust steam is withdrawn and reduced in pressure to such an extent that it is not practical to heat the feed water, which is taken from a hot well at a temperature of about 100° to over 140°, when it is passed into the boiler.

By the device here shown, steam of less pressure than that carried in the steam receiver is utilized, and the maximum amount of water is heated by the minimum amount of steam, the same being reduced by either or both of the valves *J* and *K*, as desired. The air in the heater escapes by the outlet pipe *L*, the check valve *N* preventing its return, unless the vacuum is too great, when the automatically operating inlet air valve *M*, which can be weighted to any desired extent, will admit the required amount. The water-inlet pipe *W*, which supplies the pipes *R*, is provided with an automatically-operating valve *X*, operated by the movement of a float and connected mechanism of usual form.

As the heater receives the steam from the receiver, a constant supply may be readily furnished to the pipe *G*, and thus to the heater, and owing to the reducing valves, at any desired pressure.

The object in this design is to take the water from the hot well or other usual source, or if there is a coil heater between the last cylinder and the condenser to take the water from that at the maximum temperature which can be obtained and feed it into the water inlet *W* of the drawing, whether upon the top or side, the manner in which it enters being immaterial. Then to heat it to a higher temperature by steam from the steam receiver after a portion of the energy of the steam has been utilized in the steam cylinders from the time it left the steam boilers under full pressure before it entered the steam receiver. From the steam receiver is taken just the quantity of steam which is sufficient to heat the feed water to 210° or 212°. To accomplish this is used the branch pipe *G*, with a pressure reducing valve located in it from the steam receiver to the vacuum heater, and by this the pressure is cut in the steam pipe leading from the reducing valve into the vacuum heater to as near steam at 212° or atmospheric pressure as possible, since steam at atmospheric pressure contains a greater number of latent heat-units to accomplish the desired object, which is to heat the water more economically than if the full steam pressure carried in the steam receiver were carried in the vacuum heater on account of the vacuum heater, which may be made in any form of a tank, so long as there is no opening to the atmosphere. The pump, which is ordinarily connected to the heater, would not then operate satisfactorily on account of fluctuation of vacuum. To overcome this objection the air inlet or vacuum valve *M* is used so as to communicate with the inside of the vacuum heater, and by which it is possible to allow a proper amount of air to enter by setting the valve to any degree of vacuum desired.

An overflow pipe, *Y*, of larger diameter than the water supply pipe *W*, leads from the heater, so as to prevent the water from accumulating beyond a given or indicated level. The overflow pipe *Y* is provided with a valve *Z*, having a lever *A'*, which is weighted so as to close the valve to prevent air from entering the heater in case of a partial vacuum at any time, but adapted to open it when the pressure in the heater exceeds a desired amount.

The Improved Coze Gas Retort.

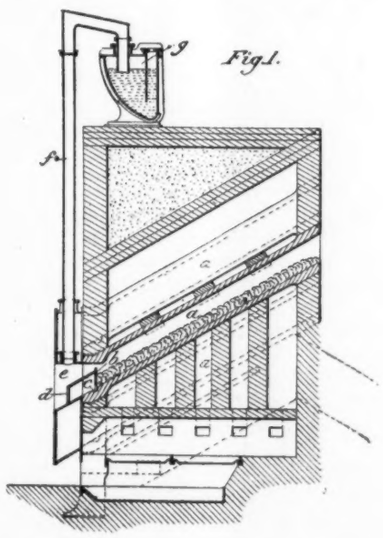
On June 28 U. S. Letters Patent (No. 477,834) were granted to M. Andre Coze, of Paris, France, for an improved method of constructing inclined gas retorts. Using the words of the specification:

The present invention relates to an improved means and arrangement of parts for effecting the ready discharge of gas retorts; and to this end the retorts are arranged at the angle of repose and charged from the upper end, and provided with a removable stop plate at the lower end to prevent the coal from entering the mouthpieces on the lower ends of the retorts, from which mouthpieces the gas is led off to the hydraulic main, whereby, when the removable stop-plate is withdrawn, the retorts may be readily discharged by the coke sliding down the incline of the retorts, and thus effect a saving of labor. By the angle of repose I mean that angle at which the natural fall of the coal when charging a retort from the upper end is sufficient to cause the distribution of the charge in a uniform layer throughout the whole length of the retort parallel with the bottom thereof, or that angle at which the material of its own weight begins to slide down the incline of the retort. The retorts may be automatically discharged by removing the stop plate referred to and loosening the coke from the sides of the retort, whereupon the coke will slide down the inclined retort without difficulty and effect the automatic discharge of the retort; or the discharge of the retorts may be accomplished by removing the stop-plate and applying slight force to the coke, whereupon the coke will be

readily discharged from the lower end of the retorts by sliding down the incline of the same. The removable stop-plates should be applied to the lower end of the retorts, so as to keep the coal out of the mouthpieces upon the lower ends of the retorts, from which mouthpieces the gas ascension pipes lead to the hydraulic main.

The invention will be best understood by referring to the accompanying drawings, in which Fig. 1 is a sectional elevation of a gas retort bench, provided with inclined retorts located at the angle of repose, showing one of the retorts in section and furnished with a removable stop-plate at its lower end. Fig. 2 is a sectional elevation of the front part of a gas retort bench, showing three inclined retorts in section at the angle of repose, each retort provided at its lower end with a modified form of removable stop-plate. Fig. 3 is a plan view of the modified form of removable stop-plate shown in Fig. 2 applied to the middle retort. Fig. 4 is a front view of the same, looking in the retort. Fig. 5 is an elevation of the removable stop-plate shown in the lowest retort in Fig. 2, and Fig. 6 is a plan view of the latter.

Fig. 1.



The same letters of reference indicate the same parts throughout the several views.

a represents the retorts, placed in a suitable retort bench or setting, at an inclination approximating to that of the angle of repose of the matters with which the retorts are to be charged, or, in other words, at an inclination almost verging on the limit at which the matters to be subjected to distillation would commence to slide down the retorts. This inclination is represented in the example shown as 29°; but it is evident that this angle may be varied to suit the nature and smoothness of the interior of the retorts, the size of the lumps of coal, etc.

The present invention is independent of any special means of charging the retorts, and does not depend upon the retorts being brought to the same or to any particular level, or upon the retorts being arranged in any special way, except that the retorts should be placed at the angle of repose and charged from the upper end, which may be done in any suitable manner.

By placing a retort at the angle of repose and charging it from the upper end the charge may be distributed in a layer of uniform thickness without entirely filling the retort—that is to say, the plane of the surface of the charge is about parallel with the floor of the retort, leaving considerable space above the surface of the charge and the top of the retort, which is the most favorable condition for distillation, as it leaves sufficient space in the retort to allow of the gases freely disengaging, and enables the distillation to be carried on under the ordinary conditions, as when retorts are charged horizontally.

The arrest of the coal at the lower end of the retort may be effected by means of a removable stop plate *b*, fitted in grooves, *c*, in the retort and supported by a leg *d*, resting upon the lower part of a mouthpiece *e*, fitted over the lower end of the retort. From the top of the mouthpiece *e* extends a gas ascension pipe *f*, leading to the hydraulic main *g*. By utilizing the angle of repose, which permits but a slow passage of material, each particle of coal as it is arrested acts to hold the others in check, thereby preventing the retort becoming filled and permitting the distribution of the coal in a uniform layer, as stated. The retaining plate *b* does not extend to the top of the retort, but stops short of the top, so as to leave sufficient passage for the gases disengaged from the coal to pass into the mouthpiece and from thence into the gas ascension pipe *f* to the hydraulic main *g*. As the inclination given to the retorts is nearly sufficient to produce a sliding of the materials contained in them, it will be understood that the least impulse given to the coke will be sufficient to produce an automatic discharge of the coke from the retorts.

It is evident that my system is independent of that of the furnace and may be applied to all kinds of gas furnaces and to all shapes of retorts. Such applications would only require some slight changes in details.

In Fig. 2 the upper retort is shown as provided with an ordinary lid *h*, to which is attached the stop or retaining plate *b*, so that when the lid is removed the stop-plate will be withdrawn from the retort and the retort may be readily discharged.

The middle retort Fig. 2 is shown as provided with a cast iron retaining plate *b*, hooked upon lugs *k*, on the head or mouth-piece *e*, of the retort by means of hooks *l*, secured to the retaining plate. The said retaining plate is divided with a midrib *m*, having a hand-hole therein to admit of the removal of the stop-plate.

The lowest retort in Fig. 2 is provided with a retaining plate *b*, of sheet iron, of U form, with handles *o* at each side, and it is fixed in position by jamming or springing it against the sides of the retort mouth, *e*.

The stop plate prevents the coal from entering the mouthpieces or heads *e* on the lower ends of the retorts, which mouthpieces extend beyond the retort, setting outside of the furnace, and are consequently comparatively cool, so that if the coal was permitted to enter the mouthpieces and back up against the lids *h* that part of the coal within the mouthpieces would not be subjected to distillation. The gases being let off from the lower end of the retort cause the tarry matter to collect in the mouthpieces, and if the coal were permitted to enter the mouthpieces the tarry matter would commingle with the coal in the mouthpieces and obstruct the lower ends of the retorts, so that the discharge of the retorts could not be readily effected, certainly not automatically. Where the gas is led off from the upper end of the retort, the use of the removable retaining plate is not so important as when the gas is taken from the mouthpieces upon the lower ends of the retorts, inasmuch as when the gas is taken off from the upper ends of the retorts there is not much tendency of tarry matter collecting in the mouthpieces at the lower ends of the retorts; but the tarry matter in this instance accumulates at the upper ends of the retorts. The chief function, therefore, of the removable stop-plate is that of preventing the clogging of the mouthpieces at the lower ends of the retorts, so as not to interfere with the discharge of the retorts.

Fig. 2.

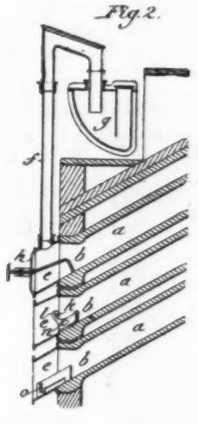


Fig. 3.

Fig. 4

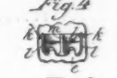
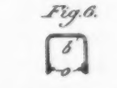


Fig. 5.

Fig. 6.



Analyses of Glass Used in the Manufacture of Incandescent Electric Lamps.

By Durand Woodman, Ph.D.

In the manufacture of incandescent lamps there is a certain percentage of loss due to what may be termed spontaneous breakage—lamps, apparently well made, cracking at some part without having been subjected to any shock or blow.

A reasonable amount of loss in this way is unavoidable, from one cause or another, but when a certain limit is exceeded some special cause is suspected, as carelessness in the glass blowing department, want of sufficient annealing, and the like.

The difficulty often passes by during the efforts to control it, without

any satisfactory explanation either of the trouble or the cause of its cessation.

The lamp bulbs may crack (a) where the platinum wires are sealed in, or (b) where the "stem" carrying the wires and carbon filament is joined to the bulb proper, or occasionally (c) where the exhausting tube is sealed on at the apex of the bulb.

In addition to the internal strains existing in any such glass work, the lamp bulb, when finished, is subjected externally to the full atmospheric pressure, and to sudden heat strains from the instantaneous turning on of current, as occurs in perhaps a majority of lamps in use.

This combination of strains being considered, it is evident that differences in the glass used for the bulb and stem and consequent differences of coefficients of expansion which, in ordinary glass work, would not be of importance, will become manifest here.

Glass blowers know that similar grades of glass should be used together, but they are able to work up grades of glass differing in composition more than is permissible in incandescent lamps.

I have had an opportunity to make some analyses of the glass used at a time when the percentage of spontaneous breakage was abnormally large, and when every care in making up the lamps, annealing, etc., was unavailing.

Analysis of Glass Rod, Tube, and Lamp Bulb.

	Rod, 108.	Tube, 109.	Lamp Bulb, 112.
K_2O	1.38	4.20	2.32
Na_2O	15.06	9.05	14.50
CaO	2.15	—	6.40
MgO	0.70	—	0.93
MnO	....	trace.	trace.
Fe_2O_3	1.02	1.65	1.45
Al_2O_3	....	....	....
PbO	16.81	19.83	1.39
SiO_2	63.44	65.16	72.35
Cr_2O_3	trace.	trace.	trace.
	100.56	99.89	99.34

These results explained the trouble from breakage in lamps made up from these grades of glass.

During the investigation, samples of glass of lamps by several different makers were analyzed; one of them, an English lamp, gave the following figures:

Analyses of Bulb and Stem of English Incandescent Lamp.

	Bulb, 115.	Stem, 116.
K_2O	5.20	6.14
Na_2O	9.20	8.10
CaO	5.41	5.05
MgO	—	trace.
Fe_2O_3	—	1.10
Al_2O_3	3.70	
PbO	2.90	10.68
SiO_2	73.10	68.24
	99.51	99.31

This bulb was a very brilliant, clear glass. While nothing is known as to the percentage of breakage in the manufacture of these lamps, it is evident that no special effort has been made to use the same glass in both parts of the lamp. Another lamp (of American manufacture) was examined and found to be of the same glass throughout, as shown below:

	Bulb, 113.	Stem, 114.
K_2O	7.17	6.91
Na_2O	6.43	5.89
Al_2O_3	0.39	1.98
PbO	18.70	17.14
SiO_2	66.22	65.80
CaO	0.45	1.25
MnO, MgO, Fe_2O_3	traces.	traces.
	99.36	98.97

It should be said here that no proof has been obtained as to the possibility that some glasses of different composition may have similar coefficients of expansion, certain constituents compensating each other; but as it is a simple matter to obtain glass of practically the same composition for all parts of a lamp or any other complex glass work, problems connected with the coefficiency of expansion need not necessarily be taken into consideration.

On the Composition of the Liquid Ammonia of the Trade and How to Manufacture Liquid Ammonia of Really 99.995 Per Cent.

[At a meeting of the Chemical Section of the Franklin Institute, held June 21, 1892, the Secretary read the above-named paper, which was contributed by Dr. Hans von Strombeck, of New York:]

If the liquid ammonia of the trade, which is generally labelled and advertised as chemically pure anhydrous 100 per cent., is allowed to evaporate, a yellow fluid of peculiar penetrating odor and basic reaction is left in the bottle. This residue was left by any liquid ammonia which I subjected to the test, though they had been manufactured of different raw materials and by different processes. But the quantities left by different liquid ammonias were quite different. It is necessary to connect a long spiral cooler with the bottle in which the evaporation takes place and to surround the cooler with a refrigerating mixture, as otherwise a large percentage of the yellow fluid is carried away by the evaporating ammonia. Sometimes also white needle-shaped crystals are left by the evaporating ammonia, which partly are deposited on the lower parts of the walls, partly swim on or are dissolved in the above-said fluid. These crystals consist of sesquicarbonate or hartshorn salt of ammonia $(NH_4)_2CO_3 + NH_4HCO_3$.

While this salt was present in every liquid ammonia analyzed, it did not appear in crystalline form every time. The basic reaction of the above-said yellow fluid is due to ammonia absorbed by the same. By supersaturation with dry muriatic acid, and removing the excess by quick-lime, a yellow neutral fluid is obtained. The yellow color is due to the presence of mineral (lubricant) oil. By distillation under reduced pressure, the latter can be separated out at 200 mm. pressure between 106° and 122° F., a colorless fluid being obtained in the receiver, while all the oil remains in the still. Besides by hartshorn salt of ammonia, by mineral oil and by "colorless fluid," as I shall call it in this paper, the liquid ammonia of the trade is contaminated by moisture and mineral matter suspended, the latter consisting of sand, peroxide of iron, etc. The mineral matter of sample B contained also sulphide of iron.

I give the analyses of six samples of so-called anhydrous liquid ammonia 100 per cent., manufactured of different raw material by different processes:

	A. per cent.	B. per cent.	C. per cent.	D. per cent.	E. per cent.	F. per cent.
Ammonia (by difference)	98.976	96.984	98.220	99.792	99.321	99.180
Moisture	0.040	0.024	0.079	0.078	0.010	0.032
Colorless fluid	0.950	2.880	1.644	0.117	0.622	0.666
Hartshorn salt of ammonia	0.030	0.099	0.049	0.004	0.043	0.087
Lubricant oil	0.004	0.006	0.005	0.009	0.004	0.035
Mineral matter	traces	0.007	0.003	traces	traces	traces
	100.000	100.000	100.000	100.000	100.000	100.000

The colorless fluid was further investigated. It has a specific gravity of 0.7948 at 60° F.; it is miscible with water, burns with little luminous flame, has a specific odor reminding of alcohol and ketone. Subjected to distillation in fractions at atmospheric pressure (758 mm.), it yielded—

(1)	2.5 per cent.	between	136°	and	153° F.	sp. gr. at 60° F. 0.8048
(2)	4.0 "	"	153°	"	165°	" " 0.8077
(3)	14.9 "	"	165°	"	172°	" " 0.8016
(4)	78.6 "	"	172°	"	180°	" " 0.7901

(Mainly consisting of methyl-alcohol and acetone; methyl- and ethyl-alcohol; ethyl-alcohol; isopropyl alcohol.)

The reaction for ketones was also given by fraction No. 2; traces could also be detected in fraction No. 3. The ketones present can only be acetone and methylethylketone. Besides also traces of ethers may be present.

The composition of different colorless fluids is slightly different, but if any of them or one of its fractions is brought into contact with metallic sodium, the whole mass at once congeals to a more or less reddish powder, hydrogen at the same time being evolved, according to the equation:

(1) $\overbrace{CH_3.OH + CH_3.CO.CH_3}^{\text{Fraction 1.}} + \overbrace{CH_3OH + C_2H_5.OH}^{\text{Fraction 2.}} + \overbrace{C_2H_5OH}^{\text{Fraction 3.}} + \overbrace{CH_3.CH.OH.CH_3}^{\text{Fraction 4.}} + 2Na_2 =$

$CH_3.ONa + CH_3.CO.CH_2Na + CH_3.ONa + C_2H_5.ONa + C_2H_5.ONa + CH_3.CH.ONa.CH_3 + 2H_2.$

As to the constitution of the sodium acetone compound which is only of theoretical interest, I refer to *Liebig's Ann Chem.*, 1891, 266, 1.

If we suppose the fractions containing two different bodies to consist of equal parts of each, and calculate the hydrogen which ought to be evolved by the decomposition of one part by weight of colorless fluid by metallic sodium, we find that 0.0179 parts by weight of hydrogen ought to be evolved. By test I found as average of four determinations that one part by weight of colorless fluid evolves 0.0166 parts by weight of hydrogen or ninety-three per cent. of the calculated quantity. Taking into consideration that the supposition on which the calculation was based is somewhat arbitrary, a better agreement can hardly be expected. As one part by weight of hydrogen requires twenty-three parts by weight of metallic sodium for its evolution, one pound of colorless fluid requires 0.38 pound of metallic sodium for its transformation into solid sodium compound.

A reaction similar to that between colorless fluid and metallic sodium takes place between the latter body and two of the other above-mentioned contaminations of liquid ammonia, viz: Moisture and hartshorn salt of ammonia according to the equations.

(II.) $2H_2O + Na_2 = 2NaOH + H_2$; and

(III.) $[(NH_4)_2CO_3 + NH_4HCO_3] + 2Na_2 = 3NH_3 + 2Na_2CO_3 + 2H_2$.

Based on the reactions which have been given in these three equations, I devised a process for the manufacture of liquid ammonia which on the average contains 99.995 per cent. of ammonia, 0.005 per cent. of mineral oil and nothing else (U. S. Patent 477,089), the removal of the oil being impossible because of its chemical nature. The process is as follows:

The ammonia gas which has been manufactured by one of the usual processes, and which has been already freed of the bulk of its moisture, instead of being directly drawn into the compressor, is first led through a vessel filled with molten metallic sodium. Here in this vessel the reactions described in the above three equations take place, whereby all contaminations present are transformed into solid non-volatile bodies and remain in this vessel, only ammonia gas and the hydrogen evolved escaping out of the same. The melting point of metallic sodium being at 204° F., it can easily be kept in a molten state by return steam which circulates through a jacket surrounding the vessel with the sodium. The ammonia is better led through two such vessels so as to make sure that all metallic sodium in the first one is exhausted before it is filled anew. By suitable connections the ammonia can be made to enter either vessel first or last. From the second vessel the now perfectly pure ammonia gas is drawn into the compressor and transformed into liquid in the usual way. From this description it will be seen that the apparatus required is of the simplest kind imaginable.

I first thought to bring the ammonia gas into contact with solid metallic sodium spread out on trays. But the reaction between the ammonia and the metallic sodium only taking place as long as the surface of the latter is metallic, a somewhat complicated apparatus would have been required to meet this purpose. Knives and scoops would have had to be arranged in a drum in such a manner that the former continuously cut the metallic sodium to infinitesimally small pieces, while the latter carry them upward and drop them after they have reached an about perpendicular position, the ammonia gas thus having to pass through a constant shower of sodium with fresh metallic surfaces.

The hydrogen evolved is to be removed, as otherwise the engine working the compressor would have to perform useless work by the compression of the same. A very appropriate way to remove it is to have the purified ammonia gas and the hydrogen pass over palladium black or palladium gauze, each of which readily absorbs all hydrogen. Though palladium is a rather expensive article, 1 pound costing about $400, its expensiveness is counterbalanced by the fact that the same quantity of palladium can be used for an indefinite time. If heavily charged with hydrogen, it is only necessary to shut off by suitably arranged cocks the communication between the pipe filled with palladium and the rest of the plant and to lead atmospheric air through this pipe, whereby the palladium black or gauze loses all hydrogen absorbed and is ready for use again. As 1 volume of palladium absorbs 800 volumes of hydrogen, I do not think that even for a large plant more than one-half pound of palladium is required, as in the immensely finely distributed form in which it is used a small mass obtains an immensely large surface.

Now, let us see how much the cost caused by this purification process is. Let us make this calculation for an ammonia which, manufactured in the usual way, has the following composition, viz.:

Ammonia	98.976 per cent.
Moisture	0.040 "
Colorless fluid	0.950 "
Hartshorn salt of ammonia	0.030 per cent.
Lubricant oil	0.004 "
Mineral matter	traces.

Having above stated that one pound of colorless fluid requires 0.38 pound of metallic sodium, 0.36 pound of it is here required. One pound of metallic sodium costing $1.20, the quantity required costs forty-three cents. The metallic sodium required for the removal of each one-hundredth of one per cent. of moisture costing 1.6 cents and that for the removal of each one hundredth of one per cent. of hartshorn salt costing 0.7 cents, the total expense for metallic sodium is fifty-two cents per 100 pounds of liquid ammonia. But 100 pounds of the ammonia in question yielding only 98.976 pounds of chemically pure ammonia, there is a loss of 1.024 per cent. The price of one pound of liquid ammonia being about thirty-five cents, the loss is equal to thirty-six cents. Or, the total increase of the manufacturing cost of 100 pounds is eighty-eight cents. But for this slight increase of cost we obtain a liquid ammonia which contains 99.996 per cent. of ammonia instead of 98.976 per cent. as at present, and therefore will easily command a much higher market price.

In this calculation the sodium alcoholates resulting by the action of the metallic sodium on the colorless fluid are considered to be without any commercial value. But this is not so. By addition of water to the sodium alcoholates, and distilling with return steam, the whole quantity of alcohols which was present in the raw material can be regained, and by introducing its market value into the calculation, the above stated increase of manufacturing cost will be considerably lessened.

While thus by my new process at a slight increase of cost liquid ammonia of 99.995 per cent. is obtained, the refrigerating power of which is, of course, superior to that of the present commercial liquid ammonia, and thus the liquid ammonia sold as "strictly chemically pure anhydrous 100 per cent." really is what it is represented to be, there is still another point worthy of consideration. Every one connected with the refrigerating business knows of the terrific explosions which now and then occur in refrigerating plants, and for which heretofore no plausible cause could be given. While I cannot positively say how these explosions originate, I should think that the presence of such inflammable bodies as alcohols and ketones point to where the cause for those explosions may be looked for. It is not at all necessary, or even likely, that the alcohols, etc., in their present form cause the explosions, but after being decomposed into hydrocarbons, etc., the latter may do so. As answer to the question of how under the conditions given in a refrigerating plant, such a decomposition can take place, I would say that this can be done by the thermo-electricity developed by the ammonia condenser. The iron return bends being tightened to the iron pipes of such a condenser by means of tin solder; and, because of the current of the ammonia gas or liquid ammonia respectively through the condenser, the tin solderings on one side of the iron pipes being colder than the tin solderings on the other side of said pipes, and the end of the condenser where the liquid ammonia leaves the same, being connected by pipes with the end where the ammonia gas enters the same, all the conditions necessary for the development of thermo-electricity are given. The electro-motive force thus developed is, of course, only very small, but in the course of time enough hydrocarbons, etc., may be generated, which, after being brought to explosion, may shatter the strongest iron pipe.

I intend to try to find out by experiment whether or not this supposition of mine be correct.

Ampere-Centimeter, a Measure of Electro-Magnetism.

[A Paper read by Mr. Carl Hering, before the Franklin Institute.]

It appears from the following deductions that an electric current multiplied by the length of the circuit will represent the number of magnetic lines of force generated by this current, or, in other words, that the number of lines of force generated by a current can be measured by the product of the current and the length of its circuit. A unit current passing through a unit length of circuit, appears to generate a certain fixed and constant number of lines of force. This, of course, has reference to the electro-magnetism of the current itself and does not include the influence of any magnetic bodies in the neighborhood.

First of all it is necessary to show that amperes multiplied by length will give a unit of a similar nature to magnetic lines of force or flux, in order to show that an equivalent between the two may be given without transgressing the laws of physics. This may be shown conclusively by the aid of the dimensions of these units in the absolute system. The dimension of current is $m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}$, while that of magnetic flux (that is,

number of lines of force, not their density per square centimeter usually represented by H or B, nor the intensity as it is sometimes called), is $m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}$. It will be seen that the former multiplied by a *length* gives the latter. This shows conclusively that ampere-centimeters, or ampere-feet and magnetic flux are units of the same kind and can therefore be equalled.

Having determined this point, the following appears to show that every unit length of a circuit conveying one ampere, generates a fixed and constant number of lines of force. Using absolute units, the intensity of magnetization (or number of lines per square centimeter) at the center of a circle of one turn, according to the well-known formula, is

$$H = \frac{2c\pi}{r}$$

which r is the radius in centimeters and c is the current.

Now, the intensity of the field is different in different parts of the area enclosed by the circle, being greatest nearest to the wire, but it may be assumed that in all circles, large or small, the ratio of the intensity at the center, to the average intensity in the whole circle, is a constant. Let this ratio be called K, then the total number of lines will be equal to the intensity at the center multiplied by the area, and by K, that is,

$$M = \frac{2c\pi}{r} \times \pi r^2 \times K = 2c\pi^2 r K.$$

By dividing this by the circumference will give the number of lines per unit length of the circuit

$$2c\pi^2 r K \div 2\pi r = C n K,$$

or per unit of current, this is equal to $n K$. It will be seen that this is a constant and is *independent of the radius r*. This means that the number of lines per unit length and per unit current is the same for all circles, and therefore also for a straight line, which is a circle of infinite radius.

From this it appears that, knowing this constant number of lines per ampere per centimeter or foot, the calculation of the total number of lines generated by any circuit or coil, would merely be the product of the current, the length of the circuit, and the constant.

It should be remembered, however, that this deduction supposes theoretical conditions; that is, a filamentary wire having no appreciable diameter. How far the size of the wire introduces an error remains to be determined. At all events, if the diameter of the wire is small as compared with the diameter of the coil, and especially if the coil, as it usually does in practice, contains iron which appears to concentrate the lines in it, and therefore probably attracts those circulating in the body of the wire itself, it may doubtless be assumed that the ratio of the flux in two coils would be equal to the ratio of their ampere-feet, which proportion might be of use in dynamo construction.

The above deductions were made by the writer a number of years ago, but as they did not appear to agree with some existing laws at the time, the matter was laid aside. It seems, however, that subsequently some dynamo builders have advocated and used this system of calculation in preference to the other, and it was therefore thought best to publish this proof, hoping that some others, well informed on this subject, might point out the discrepancies, if any, and perhaps show the extent of the application in practice of calculating the magnetic flux of a current from the ampere-centimeters of the circuit.

Lighthouse Illumination.

The *Scientific American* says that in the present day, the majority of lighthouses in the United States, or practically all, depend upon kerosene oil as their illuminant. In old times, the first representatives of warning lights on shore may be supposed to have been bonfires, succeeded in their turn by braziers. It is believed that the Colossus of Rhodes held in his upstretched hand a brazier in which a fire was maintained to guide vessels into the harbor. His modern successor, the Goddess of Liberty, in the harbor of New York, carries an electric torch, in virtually the same position that her prototype is supposed to have held his brazier. Candles also played their part in the illumination of lighthouses; but in modern days everything has given way to the oil lamp, with very few and isolated exceptions.

A representative of the early oil lamp was adapted to burn lard oil, and in order to prevent the oil from chilling, a curved copper rod extended from a point well above the chimney down into the oil, and terminated above the chimney in a small ball. The waste heat of the flame thus maintained the oil in a heated state. Eight to 24 of these lamps were mounted on a single armature. In Montauk Point light, 24 of them were used, and were removed in 1853. They originally burned sperm oil, which was afterward changed to lard oil. This lamp was fitted with a reflector illustrating the reflecting or catoptric system of lighthouse illumination.

Its successor was a French mechanical lamp for colza, sperm or lard oil, which was used in lenticular burners. In this machinery pumped the oil up to the wick, whence it continually overflowed. The machinery was objectionable and the lamp was superseded in time by Funck's hydraulic float lamp, in which the oil was carried in a reservoir surrounding the upper part of the prolongation of the chimney, thus being kept warm and fluid by the waste heat. In its course to the wick the oil passed through a chamber containing a float. The float was adjusted so as to rise and close by a valve the oil inlet as soon as the oil reached the proper height in the wick reservior, thus maintaining the oil always at the same level. Lard oil was the fuel of this lamp. Professor Joseph Henry, who took the most active interest in the lighthouse establishment of the United States, and who was constantly experimenting in the laboratory and field upon the subjects of night and fog signals, introduced lard oil, thereby saving $100,000 per annum. The year 1864 is the date of this change. He was greatly interested in the development of the Funck lamp just described. As kerosene has improved in quality, the time came, about 1873, when it naturally superseded the more expensive lard oil. For its combustion in the smaller lighthouses the lamp known as the Funck-Heap lamp was devised. This is the product of the ingenuity of Mr. Joseph Funck and Major D. P. Heap.

It is a standard Argand lamp with single wick. The feed of the wick is effected by a screw thread on the wick-carrying tube, as in the student's type of lamp. The chimney is carried in a gallery, which furnishes a support for it, and in which it can stand erect when removed from the lamp. A brass deflecting cap surrounds the wick, and around its base this cap is perforated with a number of holes. The holes admit cold air, which, forming a mantle around the flame, protects the chimney from intense heat, which would whiten or might even melt it. A deflecting button is carried by a spindle in the center of the flame. This button gets nearly red-hot, and the air rising and impinging upon it becomes undoubtedly materially heated, so that a certain amount of regenerative effect ensues. This lamp is rated at 50-candle power. Its wick is 1¼ inches internal and 1½ inches external diameter. Its flame is so white and intense that it is almost painful to look at. It burns 1½ gills of oil per hour, 202 gallons being allowed for its annual consumption.

For the larger lights larger lamps are used. Of these some are known as the first order five-wick burner, rated at 500 candles, which is used in the first order lighthouses. Then comes the first order kerosene lamp, on which such burner is mounted. This lamp is a float lamp embodying the float valve already described. To force the oil up from the reservoir below, a weighted piston is used. This piston, with leather packing, tightly fits the cylindrical oil chamber below the burner. It is weighted, and contains a valve opening downward. Its weight forces the oil up to the chamber and thence into the wick chamber. As required, the piston is drawn up by turning the handle, the downward opening valve permitting this to be done, and is then again released when its weight again comes into play, and the oil is forced upward.

In practice, the piston is raised once a night and feeds ½ gallon per hour. Its total feeding capacity is 8½ gallons. The annual supply of oil to such a burner is 2,156 gallons. In the float lamps the oil is maintained constantly at a level of 1½ inches below the top of the wick.

To trim the wick the valve is shut in the supply pipe, and the lamp is allowed to burn out, which it does very soon. After cooling, the wicks are then brushed off, no attempt being made to cut them. In the Funck-Heap lamp the trimming is effected also by rubbing off the wick after the oil has been burned out.

The lenticular apparatus in which these lamps are burned is universally of the Fresnel order of construction. Where the entire horizon is to be lighted, it is obvious that the lamp might be surrounded by a species of cylinder whose longitudinal section as regards each side would be lenticular. This construction would exact an immense thickness of glass for the center part. To avoid this the lens is broken up into a series of prisms, with the exception of a small portion of the center. These prisms are bent around to the shape of the lens chamber, and are so cut as to represent sections of a lens as it would be at each position of a prism. Thus immense structures are built up, the first order lenticular apparatus, being large enough to contain a number of men, while the second order and fourth order lenses are, of course, of considerably smaller size. The smallest regular lighthouse lens used is the fifth order, and below this, for special purposes, come special lanterns; some with true Fresnel lenses, others with as near an approach to them as can be got in pressed glass.

The lenses may be disposed in annular segments, in which case their concentration of the rays of light is altogether in the vertical direction, the light, as it were, being converted from a sphere of dissemination to what is almost a disk. Sometimes flash lights are required. These are produced by having the prisms and glass of the lenses so ground and mounted as to represent a number of true leses, which send the light out, not in discoid distribution, but in a definite number of radiating beams. If such a lenticular apparatus is rotated, it will carry with it around the circle of the horizon these beams, producing for the onlooker the effect of a corresponding number of flashes per revolution of the lens. For color effects colored glass chimneys were at one time used, but proved expensive on account of their fragility. They have been replaced by colored glass shades.

An application of the circular lens to lamps is shown in the range light, one of the largest in the world, and which is to be one of the exhibits at the Columbian fair. The back of the light is the characteristic part of the apparatus. This consists of a set of totally reflecting prisms cut at such an angle and so set as to reflect back all the light which falls upon them. Thus this range light utilizes a great part of the light which would otherwise be totally wasted. It is open at the sides so as to give the most convenient access possible to the lamp.

The type building in which these lights are placed, can be seen at Execution Rock light-house. This is situated on Long Island Sound, a little north of a line connecting Glen Island with Sands Point, about twenty miles from the Battery. It is one of the older structures, and in former days the keeper used to live in the lighthouse itself. Since those times a very substantial stone house has been built for his accommodation and a powerful fog signal is established to warn approaching vessels while still far from it. The light, formerly a stationary one, is now a flashing light, while the Sands Point light a mile distant is fixed.

The oil used by the Lighthouse Department must conform to the following test: It must be of 140° flash test, 154° fire test, about 0.800 sp. gr., and free from acid, and, burnt in an Argand burner of the Funck-Heap style, light must show 18 candles illuminating power on a consumption of $4\frac{1}{2}$ of a gill per hour. In 1873 the use of kerosene was commenced on a small scale; its use is now universal in the United States.

The electric arc lamp, apparently very powerful, is found to be very unsatisfactory in fogs, owing to its slight penetrative power. The Board do not regard its use with much favor on this account. The incandescent electric lamp, however, does meet with some applications, and probably will meet with more on lightships and similar places. Recently a number of electric-lighted buoys have been established to mark Gedney's Channel, in the lower bay of New York. Each of these carries a small Fresnel lenticular apparatus, with a 50-candle power incandescent lamp inside it. The whole are maintained by current supplied by cable from the shore. The installation, while on its face of the most perfect type, has really given a great deal of trouble, and its behavior has not been such as to entitle the system to be very favorably regarded.

Our thanks are specially due to Major D. P. Heap, U. S. A., engineer in charge of the third district, for courtesies received in connection with this article.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Superintendent Clark, of the Oneida (N. Y.) Gas Company, is overhauling the carbonizing plant, and he will also go over the main system. The Company's business is increasing at a very satisfactory rate.

Mr. Benjamin F. Kirkpatrick has been elected Secretary and Treasurer of the Lynchburg (Va.) Gas Light Company, vice Mr. T. H. Ivey, resigned.

The authorities of Westminster, Maryland, have awarded a contract for the public lighting of the city to the Westminster Gas Light Company. The agreement is to last for three years.

The Passaic (N. J.) Gas Light Company has put two 12-inch Connelly governors in service. The Passaic Company's output is increasing at a rate that actually astonishes its proprietors.

We are indebted to a local correspondent for the following, from Detroit, under date of June 28th: "Mr. James H. Mason, who for some 20 years past has been connected with the Berry Brothers, as Secretary and Manager of their Combination Gas Machine Company, died rather suddenly Sunday morning (June 26) at his home, 463 East Congress street, of an affection of the heart. He was at his office last week as usual, and spent Saturday evening in pleasant converse with his family. His death was not entirely unexpected, although the end was very sudden. Mr. Mason, who was in his 61st year, had a wide circle of friends in Detroit, New York, Boston, Baltimore, Philadelphia, Chicago and New Orleans. The funeral services were held from his late residence on the afternoon of June 28th, and the remains were interred at Elmwood."

The water gas plant for the National Gas Light and Fuel Company, of Chicago, and erected at Station "A," of the Laclede Company, St. Louis, has just been started up. Superintendent Chollar is said to have remarked "that it started off as smoothly as though it had been running for years." The plant is intended to operate as auxiliary to the coal gas works, using hot coke direct from the retorts, with crude Lima oil, and is of a million cubic feet capacity per day, of the standard double-superheater form of the Lowe type, with scrubbers, condensers, etc., complete.

Ordinance No. 6,996, which was passed by the City Council of Columbus, on Monday June 28th, in effect extends for an unlimited period the franchise of the Columbus Gas Light and Coke Company, and also specifies the rate at which gas shall be sold in that city for the term of 10 years, beginning with the 11th inst., at which time the ordinance takes effect—it may be taken for granted the Company will formally accept its provisions. The leading sections of the ordinance are appended:

"Sec. I.—Be it ordained by the City Council of the city of Columbus, Ohio, That the Columbus Gas Light and Coke Company, a corporation organized under the laws of Ohio, and its successors and assigns are hereby granted the privilege and invested with the right to use the streets, alleys, avenues, lanes, commons, bridges and public grounds of the city of Columbus for the purpose of laying and maintaining pipes to be used for conveying gas for public and private use in the buildings and manufacturing establishments, and otherwise, of said city, together with the right to dig and excavate in all of said streets, alleys, avenues, lanes, commons, and public grounds for the purpose of laying and maintaining pipes and other appliances required to convey said gas to consumers thereof; *provided*, however, that the right to purchase the works of said Company and all the appurtenances belonging thereto at any time during the existence of the rights and privileges conferred by this ordinance, is hereby reserved by said city of Columbus, and is hereby secured to said city by said Company, its successors or assigns.

"Sec. V.—The privilege conferred in section 1 of this ordinance is granted upon the condition that the said Columbus Gas Light and Coke Company, its successors or assigns, shall annually pay to the city of Columbus, for the benefit of the gas and light fund of said city, the sum of $4,000, the first payment to be made when this ordinance takes effect and the others annually thereafter; and as a further consideration for the rights and privileges therein granted, the Columbus Gas Light and Coke Company shall sell gas for and during the 10 years next following this ordinance at a price not exceeding $1.10 per 1,000 cubic feet, and that from the above-named price a discount, at the rate of 10 cents per 1,000 feet, shall be made on all bills paid on or before the 15th day of each month for gas consumed during the preceding month, making the net price not to exceed $1 per 1,000 feet. The gas to be furnished for the above price shall be of at least 16-candle power, and the Council of said city hereby reserves the right to enforce compliance with this specification.

"Sec. VI.—When the said Columbus Gas Light and Coke Company shall file with the City Clerk its assent in writing to the terms of this ordinance, the said ordinance and acceptance shall be treated and deemed as a compliance with law, and the Council shall not for the term (10 years) aforesaid by ordinance or otherwise, require said Company, its successors or assigns, to furnish gas of 16-candle power at a lower price than that herein named; *provided*, that nothing herein contained shall be construed as granting exclusive rights or privileges, or preventing any other Company from furnishing gas to the citizens of said city of Columbus.

"Sec. VII.—The privileges granted by the provisions of this ordinance shall not be forfeited by a temporary failure to furnish gas unless such failure is through the neglect or misconduct of said Company, its successors or assigns."

Mr. Marcus Smith has done it again, and, of course, he will have to be pardoned again, with the admonition that if he does it again he will be forgiven again. The man from Wilkes-Barre, Pa., however, is dan-

gerously close to the dollar mark, hence it is likely that his lapses from ruling rates will be less frequent than of yore. However, we admire him for the "cuts" that he has made, and we respect him and his Company for the good, sound commonsense displayed by him and them in the management of its affairs. Furthermore, that management has returned to them golden eagles—a reward which always follows the efforts of those who do not want it all. To paraphrase a well-known saying, it is a fact that one can get everything for a time, and one can get something pretty much all the time, but the man does not live who gets everything all the time. This outburst is prompted by a postal card received a few days ago which carries the following terse statement: "OFFICE OF WILKES-BARRE GAS COMPANY, WILKES-BARRE, PA.—The price of gas from and after July 1st, 1892, will be at the rate of $1.30 per 1,000 cubic feet, with a discount, if paid before the 15th of the month, of 5 per cent. on bills under $20, or $1.24 per 1,000; 10 per cent. on bills over $20, or $1.17 per 1,000; and 20 per cent. on bills over $50, or $1.04 per 1,000. All special rates are rescinded. By order of the Board. MARCUS SMITH, Supt." All of which brings us back to the paraphrase, and it seems to us to put the Wilkes-Barre Company in the second division thereof; or in the class that "one can get something pretty much all the time"—qualification for that desirable class being simply the practice of dealing liberally with those you are serving.

WORK will shortly be started upon a second water gas apparatus at the works of the Calumet Gas Company, South Chicago, Ills. This plant was recently contracted for by the National Gas Light and Fuel Company, of Chicago, and consists of a complete set of double superheater Lowe type, 200,000 cubic feet capacity, including pumps, operating floor, oil tanks, etc.

THE Philadelphia (natural) Gas Company has abolished its local office at Braddock, Pa., and all contracts concerning a gas supply there will have to be made at the Pittsburgh home offices.

REFERRING to the reported sale of a very large block of stock, held in Milwaukee, in the Milwaukee Gas Light Company, which sale was reported broadcast by the Associated Press, the following (from the Milwaukee *Sentinel*, of June 20th), will be of interest: "The Directors of the Milwaukee Gas Light Company deny the report, printed last evening, that a syndicate, composed of Boston and New York capitalisists, has bought the property and good will of the concern, and state that not a single one of the principal Milwaukee stockholders has sold his interest. After the publication of the statement, later yesterday afternoon, a rumor gained currency that the Edison people were the real buyers of the gas works, so as to have their principal competitor for the furnishing of light to the city out of the way, and to be able to dictate the price of the light, which would then be electric all over the municipal territory. This rumor was authoritatively denied. The most emphatic denial came from Director B. K. Miller. 'All I can say,' remarked Mr. Miller,' is that there is not a word of truth to the report. I saw it in an afternoon paper, and consider this publication an outrage, because some of the smaller stockholders might be injured by it. There is not a single Director who has sold his stock, nor is there any prospect of sale. I have not sold a dollar's worth of my stock. I also know for a certainty that Messrs. Friend, A. L. Cary, Thos. A. Greene, Edward Dewey and the H. H. Button and E. H. Brodhead estates have not sold their stock. All there is to the matter is that Congressman John L. Mitchell has given an option on his stock. There was no other option given by anyone or to anyone—and Mr. Mitchell's option expires on June 30th. I do not believe that he will sell. There has been no contract made on any of the stock. Some time ago an offer was made to some of the Directors to sell their stock, but they declined to entertain the proposition unless all the other stockholders were given the right to sell at the same price. This proposition on the part of the Directors was rejected by the gentlemen who wanted to buy, and nothing whatever was consummated, nor do I believe that anything will ever come of it. I also wish to deny the statement that the sum of $1,000,000 was ever deposited in any bank in the State for the purpose of taking up the Milwaukee stock. The statement that the Edison people had been the intending purchasers is also untrue. The Milwaukee Gas Company's stock is valuable, but we do not know how our reducing the price of gas will affect the business. In a year or so we will be better able to tell.' Edward Dewey, of the firm of Dewey & Davis, also a Director, stated that he had not sold a dollar's worth of his stock. 'As far as I know,' said Mr. Dewey, 'none of the stock has been sold. The larger stockholders meet every day, and it would be very curious indeed if they would not talk over an offer to buy the stock; but the subject was never mentioned in such a manner as would have caused anyone of us to have paid any attention to it. I have not sold, and I know the Button and the Greene estates have not sold. The same applies to the bulk of the stock, which is held in the East. If it were otherwise, if that nad been sold, we would have been apprised of it.' A. L. Carey also denied having sold the stock owned by him. An effort was made to interview Congressman Mitchell by the *Sentinel's* Washington correspondent, but he was not to be found last night. In substance, the statements published last evening, which met with such unanimous denial from the Directors, were that the Milwaukee shareholders had been paid $100 per share—double the face value of the stock—bringing the total consideration paid by the 'Boston and New York syndicate' (no names given) up to $2,600,000. The capital stock of the Milwaukee Gas Light Company is $1,300,000, divided into shares of $50 each. It was further stated that John Mitchell, the largest local shareholder in the Company, sold his interest to the syndicate early last month, receiving an even half million dollars for his 5,000 shares of the par value of $250,000."

M. VICTOR VALLOIS, Secretary of the New Orleans (La.) Gas Light Company, announces that a dividend of $2.50 per share, payable out of the earnings of the past six months, has been declared. The date of payment is on the 15th inst.

WE understand that Messrs. Jones & Hovey, proprietors of the Marshalltown (Iowa) Gas Company, have secured the exclusive right to furnish electrical currents in that city, and will at once install an electric lighting and power plant—the latter to be used in operating a line of street railroad.

MR. J. W. STRATTON, of Valparaiso, Ind., the wide-awake President of the Valparaiso Gas and Electric (arc) Light Company, writing to us under date of the 4th inst., says:

"Dear JOURNAL: The local incandescent electric lighting plant was burned on the morning of June 30th. It had been running just nine months, and the parties who put it in know more than they did one year ago; but while they are richer in experience the same cannot be said of their pocket books. The demand for gas meters the next morning was imperative and persistent; but did you ever know a gas man who was not equal to almost any emergency? The people of Valparaiso are of the opinion that the old reliable gas light is not so very bad, after all."

THERE is no gainsaying the fact that gas men are, as a rule, up to the demands of the hour, and it goes without saying that Mr. Stratton is not the exception that proves the rule. As the days go by it is more plainly shown that, whatever the light of the future may be, incandescent electric lighting is not to be that light. If the service is maintained with anything approaching the needs of the lighting users, the cost to both the suppliers and appliers is excessive; and, on the other hand, if the circuits are "milked," the result of partial cheapness is acquired at a woeful loss in the lighting effect. At any rate, gas is still the light of the present.

THAT Captain White can do more than lead the "Old Guard," secure fat contracts, conduct a banquet, direct the affairs of the American Gas Light Association from the President's coign of vantage, to say nothing of other and multifarious occupations, is shown in the executive department of the Little Falls (N. Y.) Gas Light Company, in the gas stove campaign recently begun at that point. The Little Falls housekeepers are not unlike other housekeepers, in that they are not blind to methods which make their monotonous round of duties less laborious and irksome. Of course, they are not gas engineers, and, unfortunately they are not free from the prejudices with which housekeepers in general regard gas companies—and gas bills; so their failure to appreciate the merits of gas as a cooking agent is forgivable, until such merits have been shown them. Again, their prejudice, or fear, that gas for cooking will come "too high" is not unreasonable, save when it is proven to them that such a use of gas is in the line of economy, especially in the summer time, when the heat from a coal range is not only not a comfort to the cook, but is a positive punishment to that influencer of our daily bread. Thus it is that the Captain was led to appeal to the reasoning powers of the housekeepers and cooks of Little Falls in the effort to put out a goodly line of gas stoves there, and he accordingly subsidized the local press by directing the appearance, alternately in the several newspapers, of a well-displayed "ad.," profusely illustrated, showing the "before" and "after" stages of the cook and household—"before," with the coal range, "after," with the gas stove. The descriptive matter is prepared in the Captain's best vein, which is sufficient notice of its excellence; and we have no doubt that the results will be a large increase

in the day sendout of the Company. The Company, of course, keeps a good line of gas cookers, etc., on show in its office quarters, and the apparatus is sold at net cost to the Company. The noteworthy offer made by the Company to those who have no gas in their houses is, provided the houses are on the line of gas mains, to run a service pipe into the kitchens and attach thereto a meter, without charge. This ought to induce many to try gas for cooking, with the likely outcome that, having once had a trial of what it could do in the summer as a cooking agent, they will pipe their houses for its use as a lighting medium.

ANOTHER liberal pledge made by the Little Falls Company is the following: "If people on the line of the gas mains who propose to become gas consumers during the present season will make immediate application for a service, so that the work can be done before the village authorities shall have the repairs to the streets completed, the Gas Company will run the pipes to the street curb lines free of charge. And, provided the sidewalk pavements be taken up and put back at the risk of the owners, the Gas Company will also extend the pipes into the houses without making any charge for the work."

THE proprietors of the Citizens Gas Light Company, of Reading and Wakefield, Mass., are mourning the loss of about $800 worth of electrical machinery that was destroyed in their electrical annex some days ago, during the prevalence of a severe thunderstorm. On the other hand, the Company has authorized Messrs. Lee & Clark to construct a coal shed (100 feet by 300 feet) close to the gas works, provision for the coal unloading having been made in the shape of an elevated trestle.

MR. G. B. BURNS has resigned the Superintendency of the Bowling Green (Ky.) Gas Light Company.

AT the annual meeting of the Cottage City (Mass.) Gas and Electric Light Company the following officers were chosen: President, Henry A. Holcomb; Clerk and Treasurer, J. Augustus Brownell; Superintendent, Lewis Bartlett; Directors, H. A. Holcomb, Samuel C. Hart, James H. McKenzie, Moses G. Howe, Fred. A. Brownell, Charles W. Holland.

THE new buildings for the water gas station (Wilkinson process) of the Rochester (N. Y.) Consolidated Gas Company embrace a retort house, and generator, purifier, and meter rooms. The site chosen is on the flats, close to Vincent place, and the buildings, which are to be of brick and stone, with ornate trimmings, will cover an area of 20,000 square feet, and the contractors (Messrs. Ellsworth & Grant) agree to have the work completed by September.

MR. C. H. WATEROUS, chairman of the Lighting Committee of Brantford, Ont., advertises for proposals for lighting that city by means of arc lights, for contract periods of 2, 3 and 5 years respectively, from Sept. 10, 1892. He also asks for proposals for the construction of a plant, to be operated on municipal account, rated to the needs of the town; again, for proposals to furnish a complete plant, save in the item of power. Specifications are on file and may be examined by contractors, and the competition will close on Wednesday next.

THE Consolidated Gas Company, of this city, will erect two workshops on the premises Nos. 337 to 341 Avenue A.

PRESIDENT KEAN, of the Elizabethtown (N. J.) Gas Company, refuses to accept as final the verdict of the Court of Errors and Appeals affirming the validity of the charter of the Metropolitan Gas Company, of Elizabeth, in that he has given notice of a determination to carry the case to the United States Supreme Court.

THE proprietors of the Exeter (N. H.) Gas Light Company have ordered a reduction in the selling rate, from $2.50 per 1,000 to $2.30.

THE hearing in the case brought about by the petition of certain residents of East Boston for a reduction in the selling rates for gas of the East Boston Gas Company, did not attract much attention. The Gas Commissioners first listened to Mr. G. W. Anderson, of counsel for the petitioners, who made a long and tiresome argument. He claimed that the rate ($1.75 per 1,000) was excessive, that the quality, in respect to lighting value (average in 1891, 16.85 candles) was far below the general average (18.13 candles) of the gas supplied throughout the State, that the management of the Company was inefficient, and that the supply was inadequate. Col. Thomas F. Doherty followed as a witness for the petitioners, but the Colonel did little more than serve as a phonograph for counsel Anderson. Mr. John Thompson, who succeeded the late Mr. Whidden as President of the Company, testified that a reduction in the price of gas had been under consideration by the Directors for some time, and that a determination would have been reached some time ago, were it not for the illness of Mr. Whidden. Continuing, Mr. Thompson said, since the organization of the Company, the price had been reduced seven times, that the Company had no intention of swindling the people, that they were perfectly willing to do what was fair, and were satisfied to accept the decision of the Commissioners. The Board subsequently inspected the plant of the Company, and took the case under advisement.

A SUIT for $15,000 damages has been brought against the Cleveland Electric Light Company by Frank B. Creighton, on account of personal injuries, which he alleges were sustained by him because of defendant's negligence. Creighton, who was employed by a livery stable keeper named Barnard, had occasion to go to the roof of the stable premises, at No. 80 Long street, on the afternoon of June 3d, and while there was seriously injured by contact with a live wire leading to defendant's station.

THE *American Manufacturer* says that the sales of gas coal lands in Westmoreland County, Pa., by J. M. Guffey, White & Co., and others during the first six months of the year have been phenomenal, to say the least, and have placed in that county over $2,500,000. The first large purchase was made by Charles G. Peters, of New York, from J. M. Guffey and J. H. Irwin, aggregating over 3,500 acres of Sewickley township gas coal. The next was by the Westmoreland Coal Company, of Philadelphia, 1,200 acres in North Huntingdon township, from White & Co., together with 1,000 acres of steam coal; the Elkins Gas Coal Company, 900 acres in Penn township, sold by Mr. Tintsman; the Penn Gas Coal Company, 2,250 acres in North Huntingdon and Sewickley township; the Youghiogheny River Coal Company, of Erie, 1,000 acres of gas coal land on the Youghiogheny river, in Sewickley township; Geo. B. Roberts, Jr., and others of Philadelphia, 800 acres in Hempfield township; Philadelphia people, identified with the Pennsylvania Railroad, 2,100 acres in South Huntingdon township.

Note on the Compressive Resistance of Brick.

Prof. Ira O. Baker, in testing some paving brick, made preliminary experiments by preparing the surfaces in five ways, viz.: 1, grinding as nearly flat as possible upon the convex side of an emery stone, and crushing between self-adjusting, parallel, cast iron plates; 2, removing the irregularities of the surface by grinding and crushing between blotting paper; 3, removing the irregularities of the surface and crushing between straw board; 4, removing the irregularities of the surface, coating with plaster of Paris and placing under slight pressure until set (12 to 24 hours), and then crushing; and 5, coating with plaster of Paris which was afterward ground down on a sandpaper disk to the surface of the brick, so as to leave a minimum thickness with a perfectly flat surface, and then crushing.

After a considerable number of experiments, it was decided that there was no great difference between the first three methods, while the difficulties in applying the last two were so great as to render them worthless. With a grade of brick which was quite uniform in quality, the first three methods gave 7,000 to 9,000 pounds per square inch as the crushing strength of cubes. The fairly close agreement of the results was considered satisfactory evidence that the method employed secured the full strength of the brick.

Subsequently the writer decided to determine the strength of cubes when the pressed surfaces were prepared with the greatest care. The samples were prepared on a rubbing bed at a marble dressing establishment, by the ordinary workmen, with instructions to secure perfectly flat surfaces. The brick were of the same grade as those referred to above, and many of the samples were the second halves of the brick used in the first experiments. The strength of the carefully prepared cubes ranged from 16,000 to 21,000 pounds per square inch, and averaged a trifle over 18,000.

The conclusion derived from the two series of experiments is that an almost imperceptible difference in the flatness of the test specimens makes a very great difference in the strength. Obviously this difference is greater the harder and more brittle the brick or stone. It is perhaps well to repeat that tests of compressive resistance of blocks of stone or brick are useful only in comparing different samples, and give no idea of the strength of masonry constructed of these materials.

It is interesting to note that Rankine and Trautwine, standard British and American authorities, in editions of their engineers' manuals published a few years ago, give the crushing strength of the best brick at 1,100 and 4,000 pounds per square inch, respectively: while there has recently been tested in the university testing laboratory three lots of brick which averaged from 15,000 to 18,500 pounds per square inch. The difference is probably due mainly to improvements in the manufacture of brick. The crushing strength of granite, when tested under similar conditions, is from 12,000 to 20,000.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

MONDAY, JULY 11, 1892.

The Market for Gas Securities.

Dullness seems to have at last seized the gas share market, but although transfers are less frequent the prices are fairly well maintained. Consolidated, of the city shares, is possibly the exception to the ruling strength, the opening price to-day (Friday) having been made at 115. Mutual is offered at 144, ex-dividend, and Equitable is very strong at 153 bid. Standard preferred was in some demand, at 84 to 87; and it looks to us that these shares are cheap. The common was also inquired after, at 30 to 36. The Company's internal affairs are now in good shape, better, in fact, than they ever were, with the likelihood that the harmony is to be permanent. Over in Brooklyn no change of moment is reported, but it may be taken for granted that by September a moving of the spirit will be seen. Col. Benson, the Nassau Company's engineering chief, is much improved in health, which will be welcome news to his legion of friends. The disquieting rumors about Chicago gas have been put down, and the shares are strong at 80. Baltimore Consolidated is cheap at 55 to 55¼, and Boston gas is quiet. The U. G. I. Company's quarterly dividend of 2 per cent. is payable on Friday next. There is no change in the Milwaukee situation. The Minneapolis Company has adopted an amendment to the by-laws under which the maximum indebtedness of the Company is limited to $3,250,000.

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
DREXEL BUILDING, PHILA., PA., June 24, 1892.

The Directors have this day declared a quarterly dividend of two (2) per cent. ($1 per share), payable July 15, 1892, to stockholders of record at close of business July 5.

891-2 EDWARD C. LEE, Treasurer.

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891-9 "H. O. C.," care this Journal.

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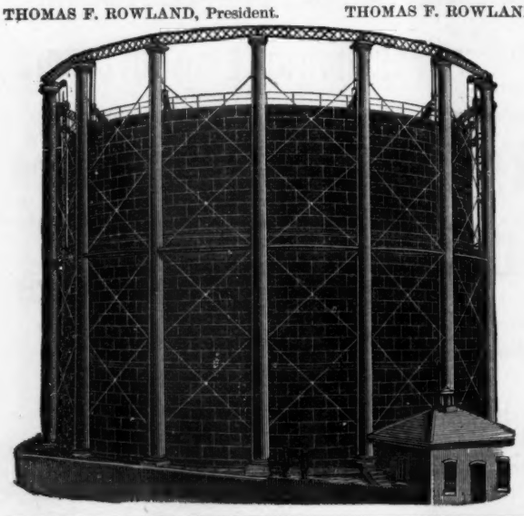

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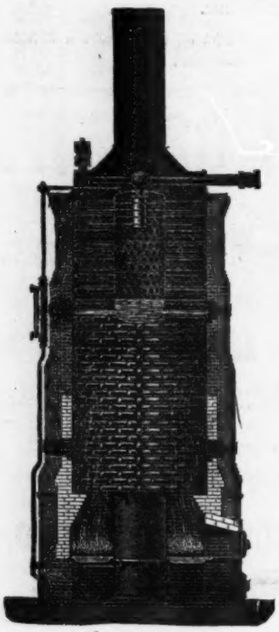

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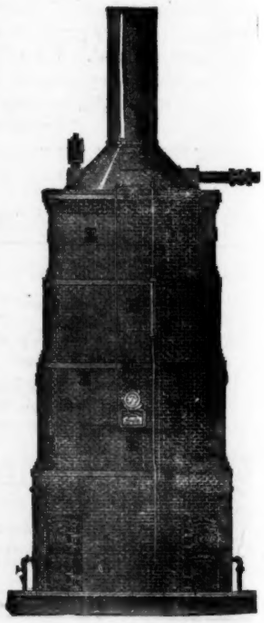

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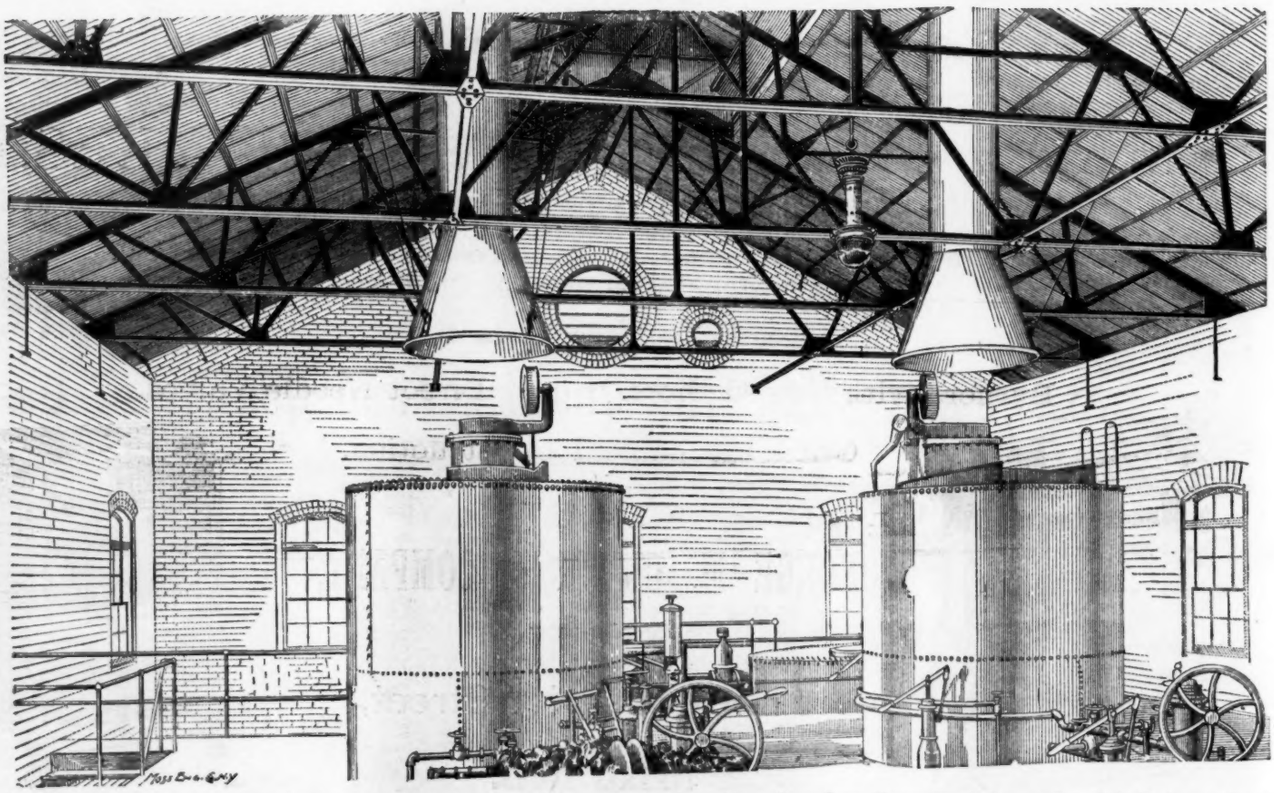

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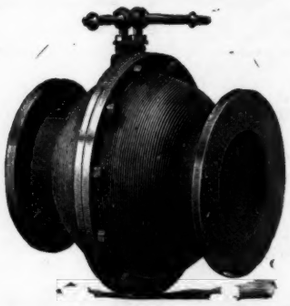

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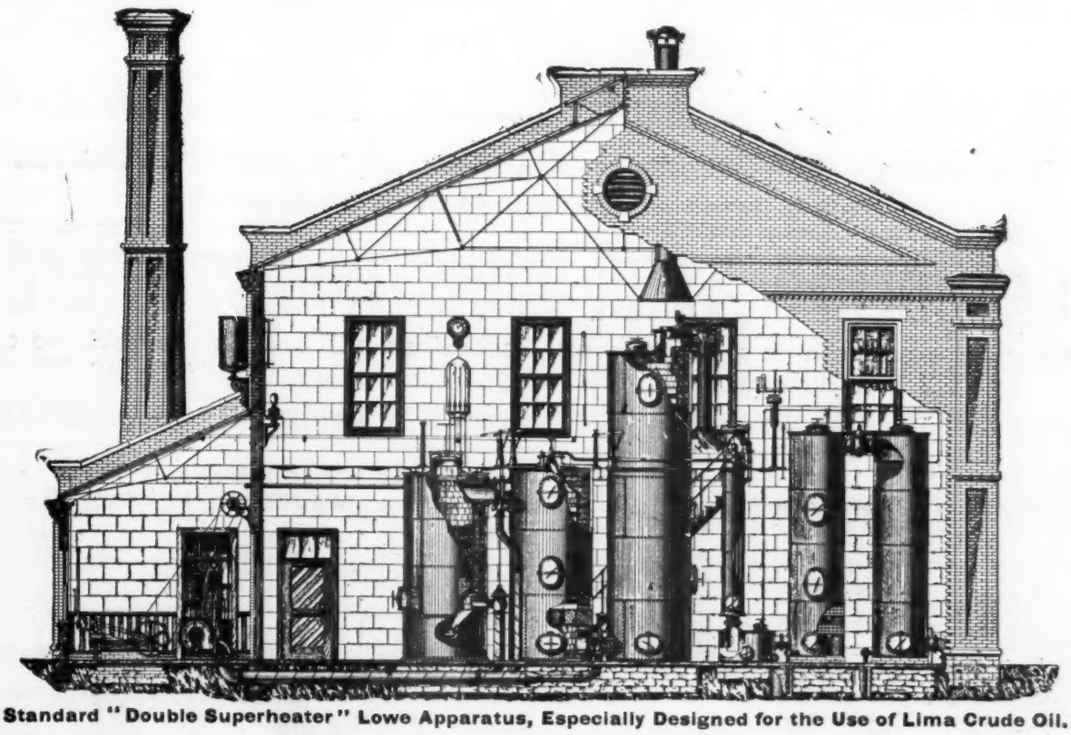

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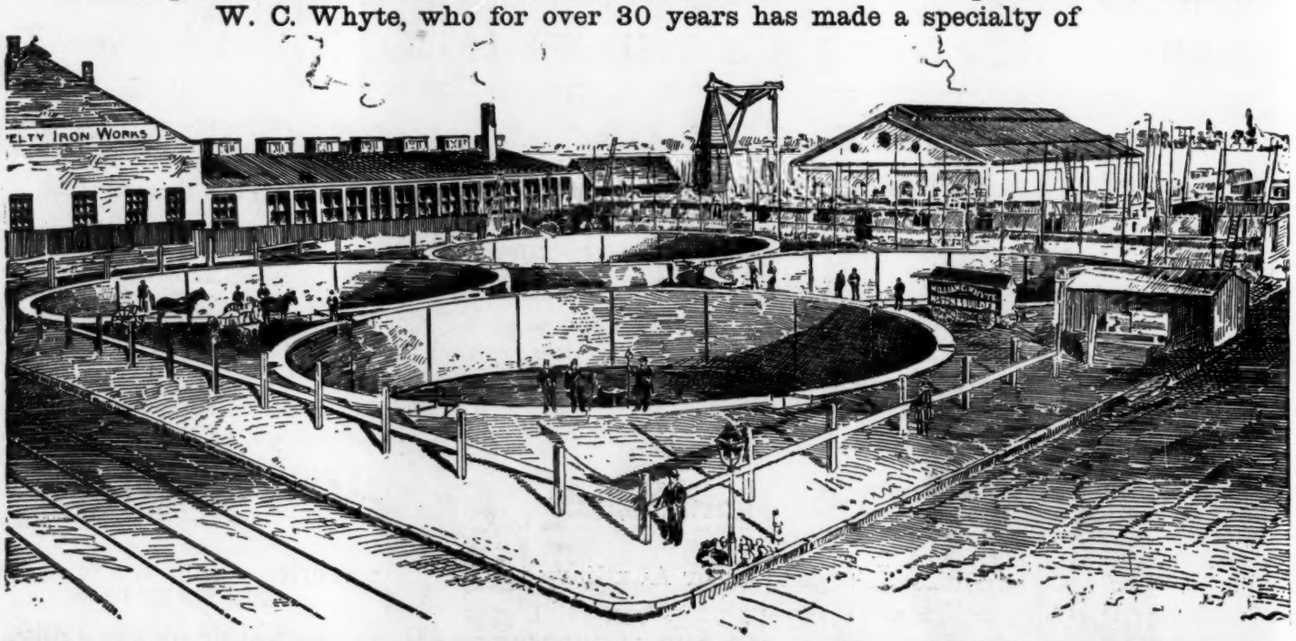

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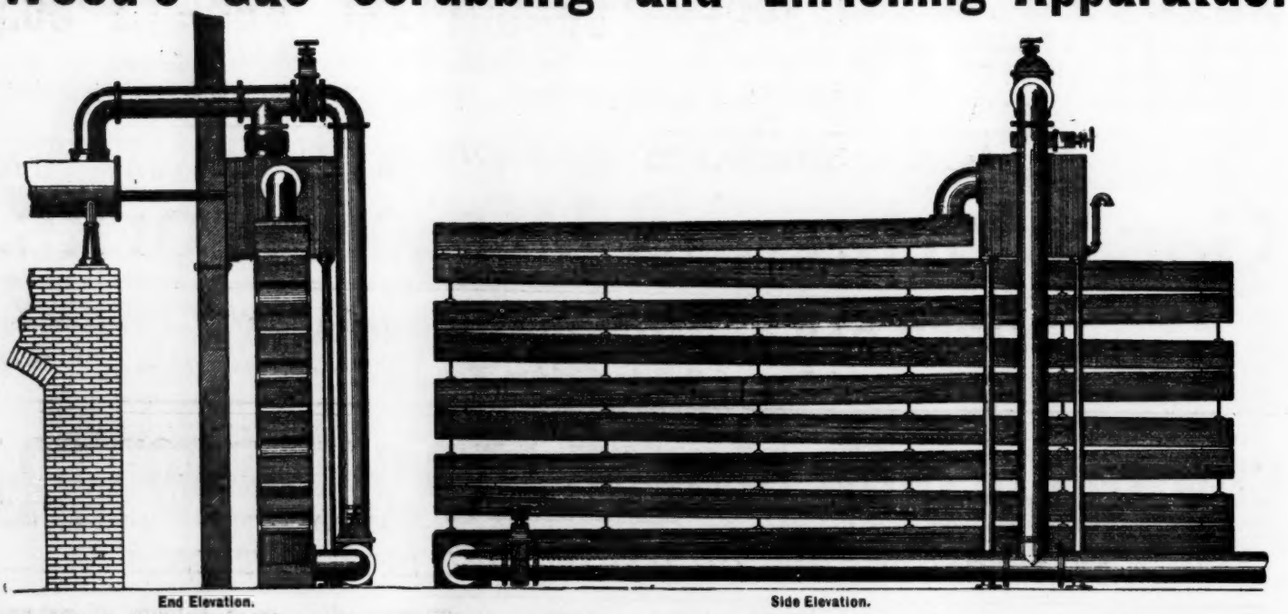

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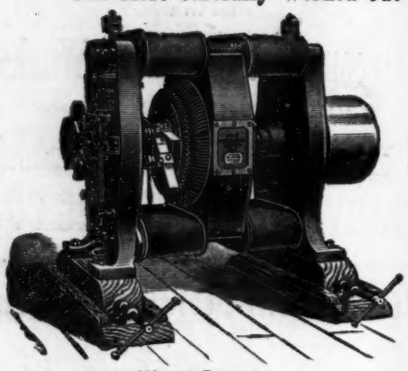

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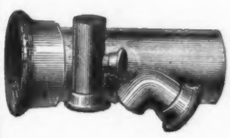

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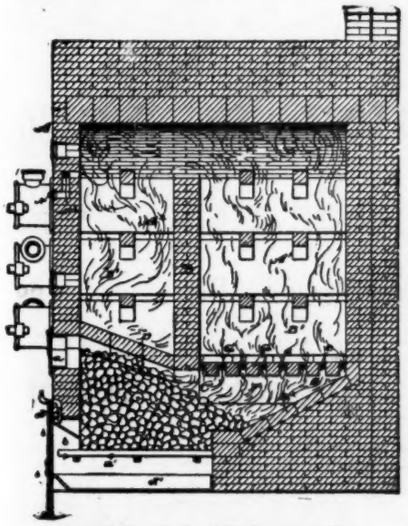

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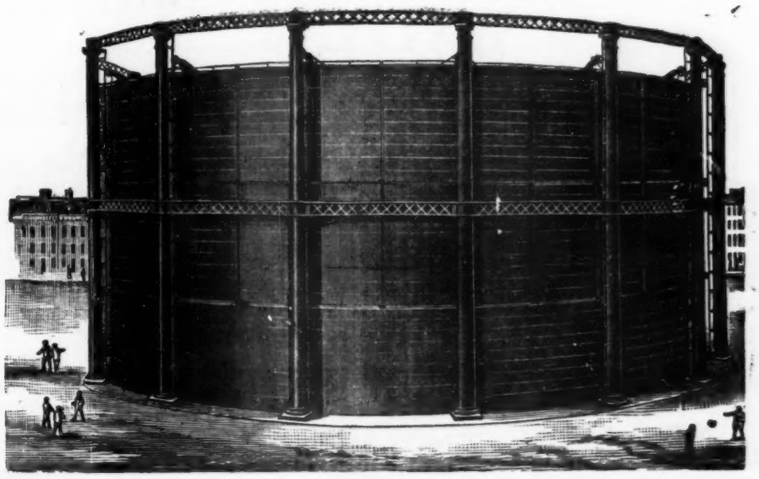

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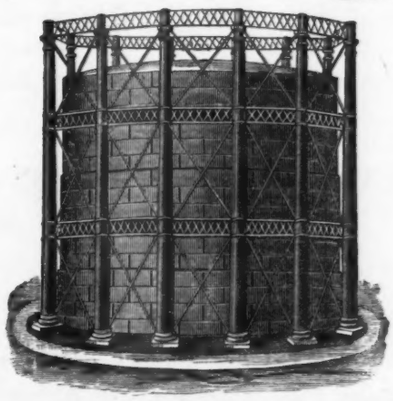

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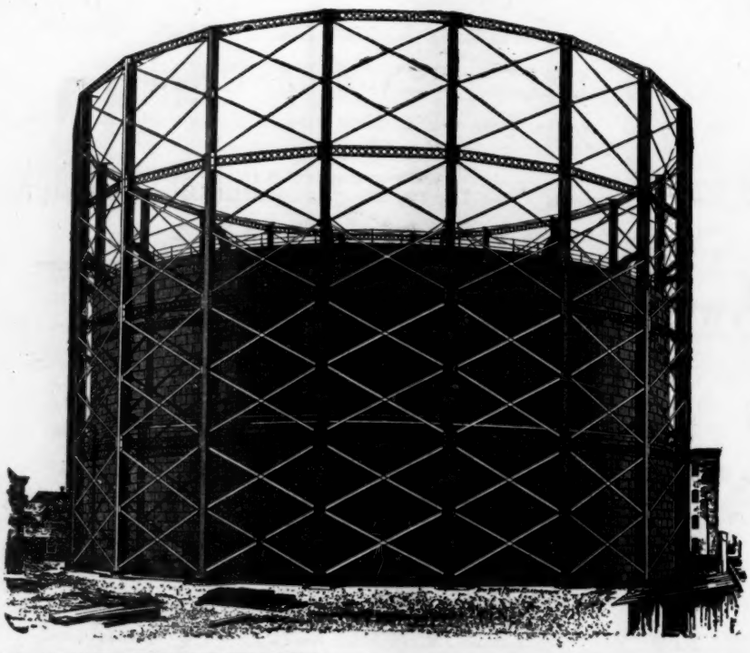

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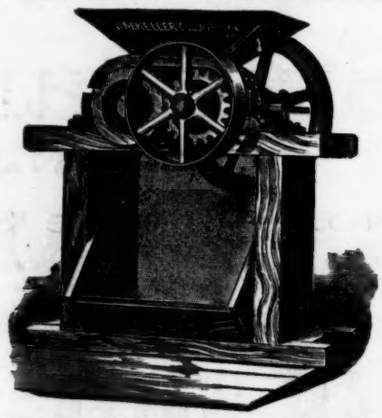

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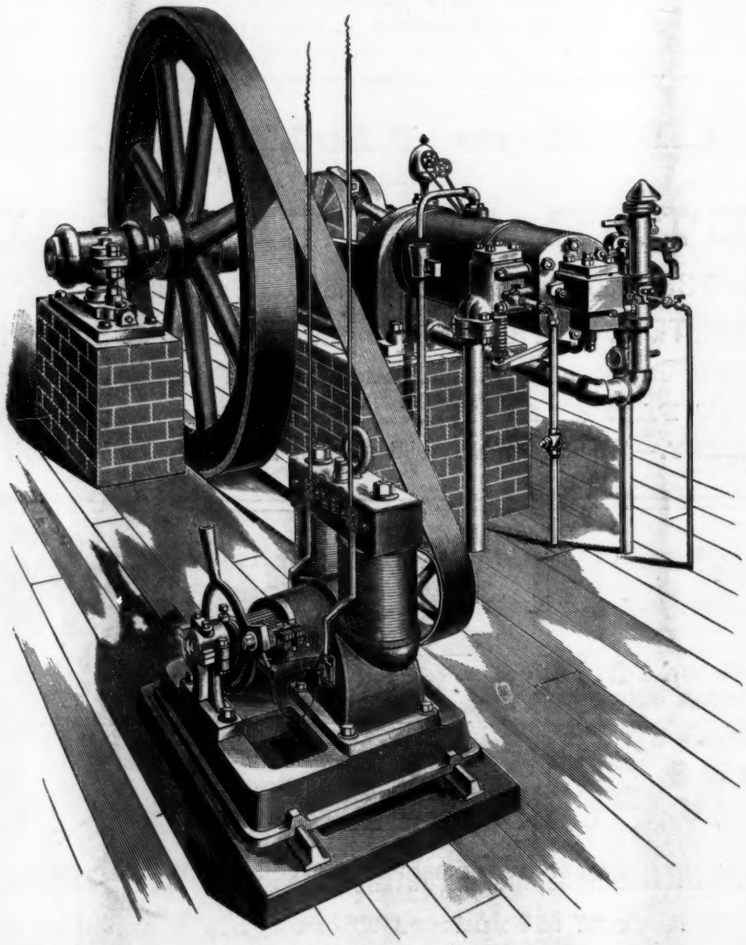

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